日小整会誌 (J Jpn Ped Orthop Ass) 21(2) : 374-377, 2012.
第21回日本小児整形外科学会学術集会 JPOA Asian Fellows

Angular Deformity in the Knee Treated Using Growth-Plate

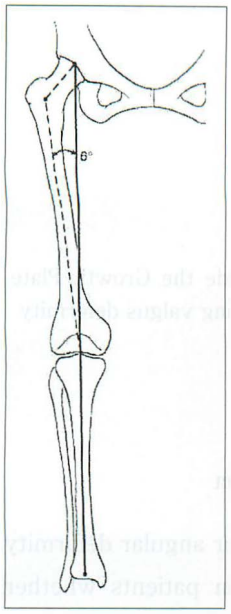
Sergei Nikolaevich Serdjuchenko, Aleh Anatolievich Sakalouski
National Centre of Traumatology and Orthopaedic Surgery, Minsk, Belarus

Abstract : Angular deformity in the lower extremity due to valgus deformity in the knee can lead to gait disturbance, pain, joint instability, early degeneration in the joint, and cosmetic deformity. Moreover the hip and ankle may be involved secondarily. Here we report the short-term outcomes after surgery for angular deformity in the knee in 17 knees involving 17 patients. There were 11 boys and 6 girls. Their mean age at operation was 9.3 years (range from 2 to 14 years). All patients presented valgus deformity in the knee joint, and were treated with the Growth-Plate mainly using stapling. Preoperatively the mean femoral-tibial angle of the deformity was 20.7° (range from 13 to 38°), compared with 5-7° in the normal knee. The mean follow-up duration to date has been 2.8 years. The average rate in correction has been between 2 and 12° per year. At most recent follow-up the deformity improved in 13 knees, and not improving in the other 4 knees. These short-term findings suggest that the Growth-Plate is a safe and effective technique with minimum invasion for treating valgus deformity in the knee in children.

Introduction

Angular deformation in the coronal plane of the knee joint leads to displacement in the lower limb mechanical axis. This valgus deformity or inside-valgus deormity can result in relative shortening in the limb, gait abnormality, and weakness in the ligaments with joint instability. The condition can lead to meniscus injury, or to overload in the lateral and medial sections with reduction in hyaline cartilage and subsequent development of degenerative and dystrophic effects in the knee and/or adjacent joints of the hip and ankle. Patients also present whirlbone subluxation due to pain in the front section of the knee joint, as well as cosmetic defects[5)6)]. The mechanical axis of the lower limb can be drawn as a line from the center of the femoral head to the center of the ankle joint (Fig. 1), and the line of the femur then gives the femoral-tibial angle. This femoral-tibial ankle is reported to be 5-7° by some authors[3)], or as 3-9° by others[2)], with the average angle in the normal knee at 6°. In order to categorize the severity of angular deformity, the knee is divided into 4 sectors (Fig. 2) where negative value indicates varus deformity, and positive value indicates valgus deformity. The normal position of the mechanical axis lies within the Sectors +1 and −1, there is slight deformity where the axis is in Sector 2, medium deformity where in Sector 3, and there is severe angular deformity[4)] where the mechanical axis lies in Sector 4.

E-mail : s.serdjuchenko@yahoo.com



◀Fig. 1.
The Femoral-Tibial Angle in the Normal Knee

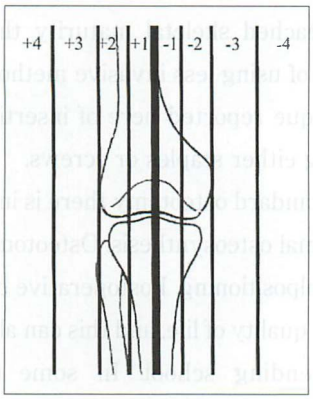


Fig. 2. The Femoral-Tibial Angle in the Normal Knee

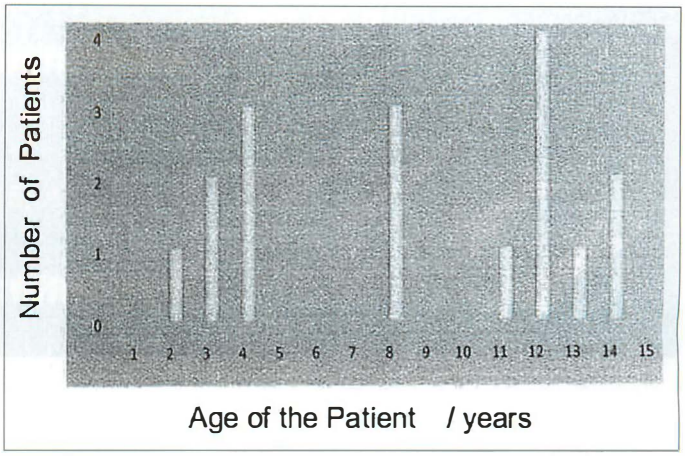


Fig. 3.
The Age Distribution of the 19 Patients

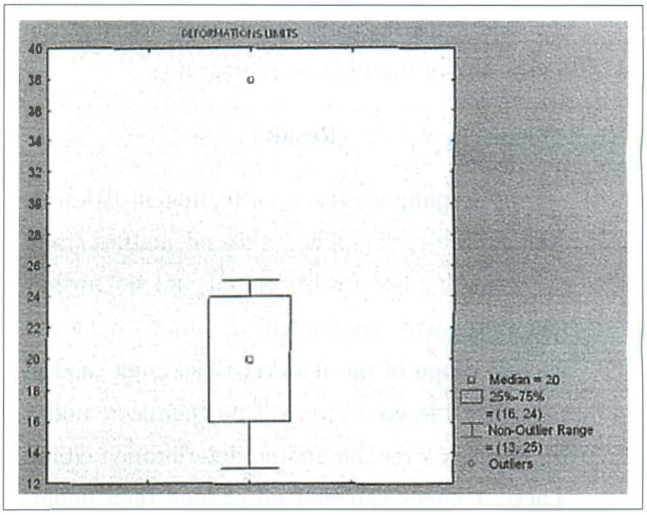


Fig. 4. The Distribution of the Angle of Talus Deformity in the 19 Knees

Materials and Methods

There were 17 knees presenting valgus deformity, involving 17 patients. There were 11 boys and 6 girls. Their mean age at operation was 9.3 years (range from 2 to 14 years). Their age distribution is given in Fig. 3. Preoperatively the mean angle of the deformity was 20.7° (range from 13 to 38°). There was one knee with severe deformity at 38°, while the angle in the other 18 knees was <25° (median 20°, 25-75% in the range 16-24°) (Fig. 4).

Surgical treatment involving minimum invasion consisted of inserting the Growth-Plate that is fixed with staples and/or screws to a bone. The Growth-Plate was designed and produced in-house in collaboration with MedBioTech, Belarus. The plating was performed on the inner part of the distal femoral growth plate in 7 knees, on the proximal tibia growth plate in another 9 knees, and on the femur and on the tibia, on the same side, in the other 1 knee. No cases received stapling of the fibula. The Growth-Plate was fixed using only staples in 10 knees, and using screws in 6 patients (Fig. 5). The Growth-Plate with an additional straight plate was used in the other 1 knee ; and in this case the growth plate was fixed using screws, and the additional line plate was

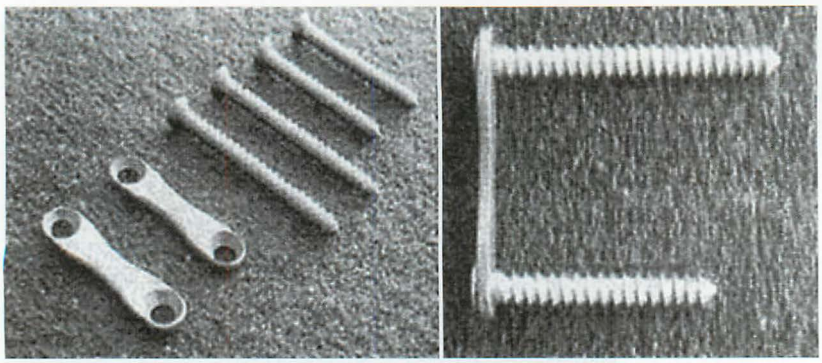


Fig. 5.
The custom-made the Growth-Plate used for correcting valgus deformity

fixed using the upper screw of the growth plate and a staple for the other end. The method of fixation was decided in each case depending on the width of the meta-epiphyseal areas of the femur and of the tibia on radiographs.

Results

Only stapling was used for fixation in 10 knees. Among these, 4 reached skeletal maturity and the growth plates were closed-and no further follow-up was conducted, 2 others achieved normal range of the femoral-tibial angle, and in the other 4 knees there was no change in angle-there was correction and no deterioration either. These 4 knees showing no change then underwent corrective osteotomy. In 3 of these 4, correction was achieved, the plates were removed, and they continue to be followed until maturity. The mean follow-up duration for these 10 knees was 2.8 years. The mean rate in correction achieved was 4.4° per year (range from 2 to 12° per year).

Screws were used for fixation in the other 7 knees. All these are still being followed. However the correction has been much greater, with the mean rate in correction achieved being 4.7° in only 6 months. In the case of 1 knee, full correction was achieved after 12 months, the plate was removed, and follow-up is continuing until maturity.

There was no complication in any of the 17 knees.

Discussion

The standard treatment for angular deformity in the knee is osteotomy in patients whether children or adults. However in children who have not yet reached skeletal maturity there is the possibility of using less invasive methods such as the technique reported here of inserting a plate fixed using either staples or screws.

In the standard osteotomy there is interruption in the normal osteosynthesis. Osteotomy can also involve malpositioning. Postoperative casting can impair the quality of life, and this can also directly affect attending school. In some cases full immobilisation is required and the patient is confined to bed for 6 weeks or so, and in many cases rehabilitation involves using crutches to walk. Full rehabilitation can take 12 months or more.

As an alternative treatment especially for a child or teenager who has not yet reached skeletal maturity, we have developed The Growth-Plate that can be fixed to the femur or tibia using staples or screws. The reason underlying our method is that the Growth-Plate on the inner region of the knee can slow or prevent growth while the outer region continues to grow, leading to correction in the angular deformity. Moreover the Growth-Plate does not affect the integrity of the bone, so the child can continue activities in daily life and in particular continue to attend school. Screws can be used provided only

that there is adequate bone area for the fixation. The technique is minimally invasive with little or no postoperative pain, so strong analgesics are not needed postoperatively. With minimum surgical invasion, the risk for any infection is greatly reduced. Full weight bearing can start on the first postoperative day, so there is short hospitalization and early return to normal life after only a few days in hospital.

In conclusion the use of the Growth-Plate on the inner part of the knee is a safe, efficient, and effective technique for treating femoral-tibial angle deformity in the knee joint area, in children and teenagers before reaching skeletal maturity.

References

1) Degreef I, Moens P, Fabry G. Temporary epiphysiodesis with Blount stapling for treatment of idiopathic genus valga in children. Acta Orthop Belg **69**(5) : 426-432, 2003.
2) Fakoor M, Safikhani Z, Razi S, et al. Study of knee angle development in healthy children aged 3-16 years in Ahwaz, Iran. Internet J Orthop Surg **16**(1) : 2010.
3) Krakow KA. The technique of total knee arthroplasty. St Louis : CV Mosby, pp86-117, 1990.
4) Park S-S, Gordon JE, Luhmann SJ, et al. Outcome of hemiepiphyseal stapling for late-onset tibia vara. J Bone Joint Surg **87-A** : 2259-2266, 2005.
5) Stevens PM. Guided growth for angular correction : A preliminary series using a tension band plate. J Pediatr Orthop **27** : 253-259, 2007.
6) Stevens PM, MacWilliams B, Mohr RA. Gai analysis of stapling for genu valgum. J Pediatr Orthop **24** : 70-74, 2004.