Navigation system assisted dual-plane high tibial osteotomy to treat the varus deformity of knee joint

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Objective: The navigation system assisted high tibial osteotomy can be use not only to correct the varus deformity but also to adjust the tibial slope. This will be better to improve the stability of knee joint. This paper introduced the preoperative planning, surgery technique and clinical results of the high tibial osteotomy assisted with the computer navigation system.

Method: From Jan 2006 to March 2010, there were 18 patients (20 knees) underwent the high tibial osteotomy assisted with navigation system. The inclusion criteria were: 1) Varus deformity of knee joint. The mechanical axis of the lower extremity was medial to the tibial tubercle measured by the weight-bearing full length X-ray. 2) Patients were with or without other ligaments such as anterior and/or posterior ligament injuries. Patients with acute knee dislocation which was managed with operative reduction and those with locked knee dislocation were excluded from this study. Of all the patients, the average age was 32.4 years (17~51). Thirteen patients were male and 5 female. Seven patients were combined with posterior cruciate ligament (PCL) and posterolateral corner (PLC) injuries. Four patients combined with anterior cruciate ligament (ACL) injuries. Four patients (6 knees) was simple varus deformity. Three patients were osteoarthritis in the medial compartment combined with medial meniscus tear. There were 10 left knees and 10 right knees. The weight-bearing full length X-ray was performed before the surgery to calculate the open angle needed to correct the varus deformity. During the surgery, the alignment of the lower extremity was evaluated by the navigation system. Then the virtual osteotomy plane was placed in the tibial model to evaluate the lower extremity alignment and tibial slope. When the virtual osteotomy plane was confirmed, two k-wire was drilled into the tibia navigated with the drill guide to mark the true plane of osteotomy. To correct 10 degrees of varus deformity, 10 mm thick cuneiform bone graft should be used for the open osteotomy. To improve the posterior stability, the tibial slope should be increased. To improve the anterior stability, the tibial slope should be decreased. Iliac bone plug autograft was used after the open osteotomy. TomoFix Medial High Tibial Plate (Synthes, Bettlach, Switzerland) was used as internal fixation. The patients began partial weight bearing from the sixth week postoperatively and started full weight bearing from 8 weeks after the surgery.

Results: The femoral-tibial angle was 169.4°±5.0° preoperatively and improved to 176.7°±4.7° postoperatively. The mechanical axis of the lower extremity was corrected from 13.2% (SD 18.8%) preoperatively to 36.8% (SD 18.2%) postoperatively. Among all the patients, seven cases were diagnosed as combined posterior ligament and posterolateral structure injuries, of whom the average tibial slope was adjusted from 8.28°±4.8° preoperatively to 15.7°±4.5° postoperatively ($P<.01$). There was no limited of range of motion in knee joint. And no patient complains about pain in the donor site. There was no nonunion, infection, deep venous thrombosis or other neurovascular complication postoperatively.

Conclusions: The navigation assisted medial open high tibial osteotomy can improve the alignment of the lower extremity. This technique can also be used to adjust the slope of tibia.