Minimally Invasive Open Wedge High Tibial Osteotomy with Press-Fit Tricortical Bone Graft

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Background: *Numerous operative procedures has been described for high tibial osteotomy (HTO), however the HTO without implant fixation has never been reported.*
Objective: The objective of this study was to propose a new technique and evaluate the preliminary results.
Material and Method: *Prospective review study on a series of case, at the Hospital. Seventeen patients (10 females, 7 males), and a total of 18 knees with a mean age at the operative time of 53 years (range, 35 to 64 years) were available for follow-up evaluation at a minimum of 24 months. The open-wedge HTO with press-fit tricortical bone graft was performed by one surgeon.*
Results: *The average time to union was 8.5 weeks (range, 6 to 12). There was one case of delayed union (5.5%). No nonunion, grafts collapse or dislodge were found. The average preoperative varus deformity was 8 degrees (range 6 to 11) and postoperative valgus was 8 degrees (range, 6 to 13). The pre and postoperative average pain level were 8.7 (range, 7 to 10) and 3.6 (range, 0 to 7), respectively. The average satisfaction score of the patients was 77 % (range 50-100%). The average Knee Society Score was 82.3 $\pm$ 6.4.*
Conclusion: *Considering its less morbidity, excellent cosmesis, no need for second operation to remove the implant, excellent cost effectiveness and no complications from internal fixation, this new technique offers an attractive alternative in HTO.*

Keywords: *Open-wedge, High tibial osteotomy, Press-fit, Tricortal bone graft*

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High tibial osteotomy (HTO) is a well-established surgical procedure for the treatment of medial unicompartmental osteoarthritis (OA) of the knee associated with varus mal-alignment. HTO is particularly good option for those who have unicompartmental knee disease and are young and active[1-3]. Controversy still exists regarding the methods of osteotomy, however, no special studies have been reported about the osteotomy without implant fixation[4-10]. The aims of our audit to briefly propose a new technique "minimally invasive open wedge high tibial osteotomy without implant fixation" and report the preliminary results.

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Material and Method

This study was conducted by using a prospectively review of a consecutive series of patients. A total of 18 high tibial osteotomies were carried out on 17 patients (10 females, 7 males) at the Hospital between Month August 2004 and April 2009, of which 1 patient had bilateral knee surgery. The average age of the patients at tibial osteotomy was 53 years (range, 35 to 64). The mean follow-up after tibial osteotomy was 17 months (range, 24 to 36). Seventeen patients had OA limited to the medial compartment of the knee. The candidate ideal for osteotomy is a patient who has only unicompartmental OA with limb malalignment, no flexion contracture, and knee range of motion (ROM) at least 100°. Patella baja, severe retropatellar symptoms and obvious radiographic evidence of poor bone quality were excluded from the series. The preoperative and postoperative standing

tibiofemoral angle measurements for each patient were taken on the radiographs. The patients were functionally evaluated pre and postoperatively by the Knee Society Score. In this score system, 100-85 points is excellent; 84-70 is good; 69-60 is fair and under 60 is considered bad. In addition, a subject grade between 0 and 10 was given by the patients according to their level of pain and satisfaction with the surgery.

This study was approved by the ethics committees of the institution. After the patients have been fully informed about the procedure of the study, those who wished to participate signed the appropriate informed consent form.

Statistical analysis

Descriptive statistics were used and presented as mean values with range.

Surgical technique

We exposed the anteromedial aspect of the tibia through a 3-cm vertical skin incision centered between the tibial tubercle and posterior edge of tibia. We started every osteotomy with a routine knee arthroscopy to treat any intra-articular pathology: appropriate joint surface debridement, partial meniscectomy, or loose body removal was performed if needed. The medial collateral ligament was subperiosteally elevated to expose the medial proximal tibia. The joint line was identified, and two K-wires were inserted medially, 3-4 cm distal to the joint line under image intensifier control as a guide for the osteotomy (Fig. 2A).

To prevent intra-articular fracture, the osteotomy was performed distal to these K-wires but proximal to the tuberosity that was slightly undercut with an oscillating saw (Fig. 2B). The osteotomy was completed using osteotomes; the lateral tibial cortex was left intact. We protected the medial collateral ligament, neurovascular structures with broad curve Hohmann retractors and protect patella tendon anteriorly with a retractor. The osteotomy was carefully and slowly opened, inserting 3 to 4 chisels on top of each other to the demanded amount of opening, where 1 mm of opening corresponds approximately to 1 degree of correction (Fig. 3A). The new mechanical axis can be checked with the coagulation cable. Two pieces of triangular shape tricortical bone were harvested from the iliac crest in the same size of the osteotomy site. The grafts were press-fit introduced to fill the defect (Fig. 3B). The medial collateral ligament was suture back into place to buttress the graft. Wound closure was performed in a general manner with a suction drainage placed subcutaneously.

Postoperative care

After the surgery the leg was immobilized with cylinder cast for 3 weeks and 0-degree knee brace for 3 weeks. Passive movement of the knee was started at the 3rd week postoperatively. Radiographic controls were performed postoperatively at 0, 2, 4, 6, 12 weeks and 6 months (Fig. 4B). Progressive weight bearing was allowed at 6 weeks.

Results

The average time to union was 8.5 weeks (range 6 to 12). There was one case of delayed union (5.5%) in which the delay was defined as absence of radiographic evidence of union at 6 months. No

Fig. 1 (A) Preoperative planning. A standing radiograph is performed. (B) Osteomy site and size of the wedge graft is drawn to get 10° of anatomic valgus alignment (overcorrection)

Fig. 2 (A) Two K-wires are inserted medially, parallelly as a guide for the osteotomy until they arrive at the opposite cortex. (B) The osteotomy is performed, keeping the osteotome below and parallel to the guide pin to prevent an intraarticular fracture

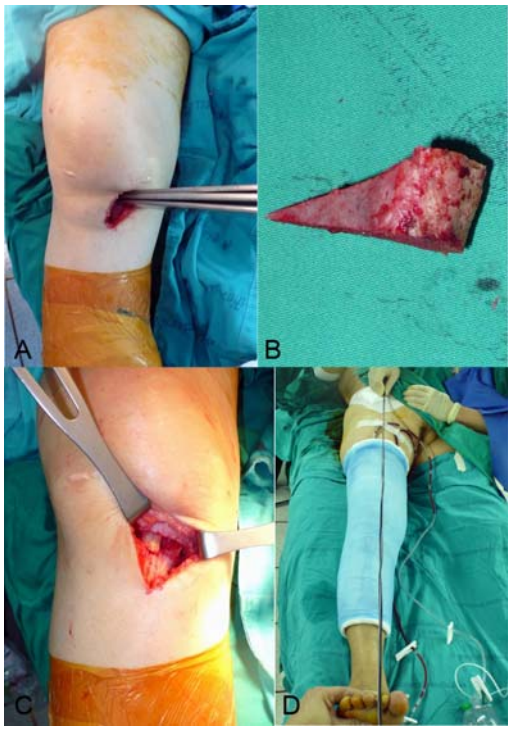

Fig. 3 (A) The 3 or 4 Chisels are inserted to the osteotomy site acting like a "wedge opener". (B) Triangular shape tricortical iliac crest bone grafts is harvested. (C) Two pieces of tricortial bone grafts are press-fit introduced to fill the defect. (D) The measurement of the mechanical axis is a line drawn from the center of the femoral head through the center of the knee to the center of the ankle mortise or the 2nd toe

Fig. 4 (A) Preoperative radiograph demonstrating severe varus deformity. (B) Postoperative radiograph reveal good alignment of the knee

Fig. 5 (A) Immobilization with 0-degree knee brace and non-weight bearing with crutches at 3rd week post-operatively. (B) Good range of motion of the knee three months postoperatively. (C) Satisfactory cosmetic appearance

nonunion, graft collapse, and graft dislodge were found in this study. The mean preoperative varus deformity was 8 degrees (range, 6 to 11) and postoperative valgus deformity was 9 degrees (range, 6 to 13). The pre and postoperative average pain level were 8.7 (range, 7 to 10) and 3.6 (range, 0 to 7), respectively. The preoperative range of ruction was 0-126□. The average satisfaction score of the patients was 77% (range, 50% to 100%). The Knee Society Score was 82.3 $\pm$ 6.4 (range, 78 to 92). Sixteen patients (94%) would choose to have the operation again.

Discussion

Open wedge HTO is a valid method for the treatment of unicompartmental OA in active patients younger than 60 years old with varus deformity of knees. Retrospectively, long-time studies have documented the efficacy of HTO, indication, planning, and techniques, and reported that it could delay the necessity of a knee arthroplasty up to 10 years[11-13]. In most cases, the patient and surgeon also consider this technique as a temporizing or time-buying procedure before the definitive total joint arthroplasty. It is important that high tibial osteotomy should not have significant negative effect on the subsequent surgery. All open- or close-wedge osteotomy need internal fixation, such as plate and screws, staples, external fixator etc. which takes higher risk of implant complications and has to be removed before the subsequent total knee arthroplasty[14]. The proposed technique has no need

to fix the osteomy site because of the press-fit tricortical bone graft insertion technique, the intact lateral cortex of tibia which acting like a hinge, intact patella tendon anterior to the graft acting like anterior buttress and short term immobilization providing the stability. In our study, only one patient had less than 50% satisfaction and 94% of patients would choose to have the operation again. In term of implant free procedure, all the patients were very satisfied with not having metal implant inside the knee and also eliminate the need for the second operation to remove the implant. In addition, the risk of internal fixation complications, such as deep infection, metal breakage, intra-articular screw penetration, can be avoided. The drawback of this procedure is the prolong immobilization which may increase the incidence of knee stiffness.

Conclusion

Considering its less morbidity, standard treatments excellent cosmesis, no need for second operation to remove the implant, excellent cost effectiveness and no complications from internal fixation, this new technique offers an attractive alternative in open-wedge high tibial osteotomy. Although this technique scores to be good, the further randomized clinical study should be done in order to compare the results with the standard or other different techniques.

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การผ่าตัดแก้ไขแนวกระดูกทิเบียช่วงบนแบบเปิดเข่าที่ส่งผลกระทบน้อยต่อกระดูกโดยวิธีฝังช่องกระดูกที่เปิดด้วยกระดูกเชิงกรานแบบกดแน่น

บัญชา ชื่นชูจิตต์, ธงชัย สุนทราภา, สัญญาณ เนียมปุก, ยงยุทธ ศิริปการ

วัตถุประสงค์: *การผ่าตัดแก้ไขแนวแกนกระดูกข้อเข่าในภาวะข้อเข่าเสื่อมประกอบด้วยหลายวิธี อย่างไรก็ตามยังไม่พบว่ามีการรายงานวิธีการผ่าตัดโดยมิต้องใช้โลหะยึดกระดูก ดังนั้นวัตถุประสงค์ของการศึกษาครั้งนี้เพื่อเสนอวิธีการผ่าตัดด้วยวิธีใหม่และรายงานผลการรักษา ทำการศึกษาในผู้ป่วยจำนวน 17 ราย (ผู้หญิง 10 ราย และผู้ชาย 7 ราย) ที่ได้รับการผ่าตัดข้อเข่าจำนวน 18 เข่า ผู้ป่วยมีอายุเฉลี่ยอยู่ที่ 53 ปี (35-64 ปี) ทั้งนี้สามารถติดตามผลการรักษาผู้ป่วยทั้ง 17 รายเป็นอย่างน้อย 24 เดือน การผ่าตัดด้วยวิธีแก้ไขแนวกระดูกทิเบียช่วงบนแบบเปิด และฝังช่องกระดูกที่เปิดด้วยกระดูกเชิงกรานแบบกดแน่นนี้กระทำโดยศัลยแพทย์เพียงผู้เดียว*

ผลการศึกษา: *เวลาเฉลี่ยที่ใช้จนกระดูกติดคือ 8.5 สัปดาห์ (6-12 สัปดาห์) ผู้ป่วยหนึ่งรายเกิดภาวะการติดของกระดูกที่ช้ากว่าปกติ นอกจากนี้ไม่พบว่ามีผู้ป่วยรายใดที่กระดูกไม่ติดหรือเกิดภาวะแทรกซ้อน จากการที่กระดูกจากเชิงกรานหลุดหรือทรุดตัว ค่าเฉลี่ยของความผิดรูปของข้อเข่าแบบวารัสก่อนผ่าตัดคือ 8 องศา (6-11 องศา) และเมื่อทำการผ่าตัดแก้ไขแนวแกนกระดูกข้อเข่าพบว่าค่าเฉลี่ยวาวกัสอยู่ที่ 8 องศา (6-13 องศา) ระดับอาการปวดของผู้ป่วยก่อนได้รับการผ่าตัดและหลังการผ่าตัดอยู่ที่ 8.7 (7-10) และ 3.6 (0-7) ตามลำดับ เมื่อพิจารณะถึงความพึงพอใจของผู้ป่วย พบว่าอยู่ที่ร้อยละ 77 (ร้อยละ 50-100) ในขณะที่ค่าเฉลี่ยของนีโซไซตี้สกอร์คือ 82.3 $\pm$ 6.4*

สรุป: *เมื่อคำนึงถึงภาวะแทรกซ้อนที่น้อยและความสวยงามของแผลผ่าตัด ตลอดจนไม่มีความจำเป็นต้องผ่าตัดอีกครั้งเพื่อนำโลหะออก ดังนั้นการผ่าตัดด้วยวิธีนี้เป็นทางเลือกอีกทางหนึ่งที่น่าสนใจ ในการผ่าตัดแก้ไขแนวกระดูกทิเบียช่วงบนแบบเปิด*