7th KOREA-JAPAN Knee Osteotomy Symposium Program

08:00 – 08:50 Registration

08:50 – 09:00 Opening Remarks **Kim Sung Jung**

President: **Lee Dong Chul**

Session 1 High Tibial Osteotomy 1 **Bae Dae Kyung/Akamatsu Y**

09:00 – 09:05 Knee Joint Line Obliquity With Adaptational Hip and Ankle Joint Orientation After Medial Open Wedge HTO **Lee DH** (Samsung Medical Center)

09:05 – 09:10 Lateral Distance From the Osteotomy Hinge Point to the Tibial Cortex Is Associated With Lateral Hinge Fracture Type and Fracture Occurrence Time After Medial Open-Wedge HTO
Yang DG, Lee BS (Asan Medical Center)

09:10 – 09:15 Linear mixed modeling on the effects of varus knee surgery on the ankle joint weight-bearing **Kwon SS, Lee SY, Yoo JD** (Ewha Womans Univ)

09:15 – 09:20 Analysis of radiographic factors affecting the significant differences in knee alignment between hip-to-talus and hip-to-calcaneus radiographs after opening-wedge HTO
Park HJ, Suh DH, Kim JG (Korea Univ)

09:20 – 09:30 Discussion

Session 2 High Tibial Osteotomy 2 **Kim Sung Jae/Akiyama T**

09:30 – 09:35 Transverse osteotomy could get closer to the posterior tibial articular surface in patients with steep posterior tibial slope in OWDTO **Nakamura Y** (Gifu Univ)

09:35 – 09:40 Factors associated with the progression of cartilage degeneration in PF joint after opening HTO

Mikami D,Kumagai K, Akamatsu T, Inaba Y(Yokohama City Univ)

09:40 – 09:45 Return to play after H-CWHTO (Hybrid closed wedge high tibial osteotomy)
Shimakawa T (Yaese-kai Doujin Hospital)

09:45 – 09:50 Double Level Osteotomy Provides Satisfactory Mid-term Outcomes for Symptomatic

Severe Varus Osteoarthritic Knees.

Ueshima R, Onishi S, Iseki T, Kanto R, Gejo R, Yoshiya S, Tachibana T, Nakayama H

(Nishinomiya Kaisei Hospital)

09:50 – 10:00 Discussion

10: 00 – 10: 20 Coffee break

Session 3 Special Japan lecture 1

10:20 – 10:30 **Takeuchi R** : Distal femur osteotomy **Kim Myung Ku/Okazaki K**

10:30 – 10:35 Discussion

10:35 – 10:45 **Kondo E** : Inverted V shaped HTO **Jung Young Bok/Sim Jae Ang**

10:45 – 10:50 Discussion

10:50 – 10:55 Award Ceremony President: **Lee Dong Chul**

Session 4 HTO & DFO Lee Beom Koo/Nakayama H

10:55 – 11:00 Detection of Lateral Hinge Fractures After Medial Closing Wedge DFO
Kim SG, Nha KW (Inje Univ)

11:00 – 11:05 Comparative analysis of gait: Similar coronal but different sagittal effects between closing-and opening- HTO **Lee DW, Han HS, Ro DH** (Dongguk Univ)

11:05 – 11:10 The impact of fluoroscopic tilt angle on the appearance of the hinge region in medial closing wedge DFO
Nakanishi Y, Hoshino Y, Matsushita T, Kuroda R, Nishida K (Kobe Univ)

11:10 – 11:15 Tibial axis inclination nearly become vertical to the ground up 24 months after double level osteotomy **Kobayashi H, Akamatsu Y** (Fureai Yokohama Hospital)

11:15 – 11:25 Discussion

Session 5 HTO & PF Joint Suh Jeung Tak/Ogawa H

11:25 – 11:30 Retro-tubercular Osteotomy Is More Favorable on 3-Dimensional PF joint Alignment than Supra-tubercular Osteotomy
Cho JH, Jade Pei Yuik Ho, Nguyen Thanh Tu, Lee YS (Seoul National Univ)

11:30 – 11:35 Patellofemoral Cartilage Degeneration After Closed- and Open-Wedge HTO With Large Alignment Correction **Song SJ, Yoon KH, Park CH**(Kyung Hee Univ)

11:35 – 11:40 Infratubercle Slope Reducing Proximal Tibial Osteotomy Can Corrects Sagittal Alignment without Affecting Coronal Alignment and Patellar Height.
Onishi S, Nakayama H, Iseki T, Matthieu Ollivier (Hyogo Medical Univ)

11:40 – 11:45 Interlocking Open-wedge Distal Tibial Tuberosity Osteotomy: A Stabilizing Technique for the Retro-tubercle without Additional Screw Fixation
Akasaki Y, Horikawa T (Kyushu Univ)

11:45 – 11:55 Discussion

11: 55 – 13: 00 Luncheon symposium Lee Young Kuk

11:55 – 12:00 ResynoOne Injection **Kim SG** (National Medical Center)

12:00 – 12:05 Discussion (Photo time)

Session 6 **HTO & Cartilage** **Han Seung Bum/Ishikawa M**

13:00 – 13:05 Clinical Benefits of Cartilage Repair in HTO Can Only be Expected in Patients with Successfully Regenerated Cartilage.
Jung SH, Jung M, Chung KH, Moon HS, Kim TH, Choi CH, Kim SH (Yonsei Univ)

13:05 – 13:10 Allogeneic Umbilical Cord Blood-derived Mesenchymal Stem Cell Implantation Combined with HTO versus HTO Alone for Medial Knee Osteoarthritis with Full-Thickness Cartilage Defects
Park YB, Lee HJ, Kim SH (Chung Ang Univ)

13:10 – 13:15 Short to Mid-term Clinical Outcome of the Iliac Bone Block Graft Combined with the AKO for Patients with Massive Osteochondral Defects at the Weight Bearing Area of the Femoral Condyle
Nakayama S (JR Tokyo General Hospital)

13:15 – 13:20 Open-Wedge HTO and Osteochondral Autologous Transfer Surgery for Medial Knee Osteoarthritis With Lateral Femoral Condylar Cartilage Damage: Midterm Outcomes in a Case Series **Yokoyama M** (Okayama Kyokuto Hospital)

13:20 – 13:30 Discussion

Session 7 **Open Vs Closed HTO** **Suh Seung Seok/Kubota M**

13:30 – 13:35 Difference in Correction Power Between Hybrid Lateral Closed-Wedge HTO and Medial Open-Wedge HTO was Associated with Severity of Varus Deformity and Different Hinge Distance from Center of Deformity. **Jung SJ, Rhee SJ** (Busan National Univ)

13:35 – 13:40 Is Severe Medial Knee Osteoarthritis a Risk Factor for Dissatisfaction Following Medial Open-Wedge HTO in Patients 55 Years of Age or Younger? **Kim MS** (Catholic Univ)

13:40 – 13:45 Medial Opening Wedge Distal Tibial Tuberosity Osteotomy Is Superior to Medial Opening Wedge HTO in Patient-reported Outcome Measures after Minimum Five-year Follow-up - 유지
Ogawa H, Nakamura Y, Ichikawa K, Ota Y, Takagi K, Akiyama H (Gifu Univ)

13:45 – 13:50 Clinical outcome of joint preserving surgery for severe and end stage osteoarthritis of the knee with Tibial Condylar Valgus Osteotomy **Teramoto T, Nishii Y**(Chikamori Hospital)

13:50 – 14:00 Discussion

Session 8 **Special Japan lecture 2**

14:00 – 14:10 **Sawaguchi T:** Is it needed bone graft in open HTO? **Lee Myung Chul/Yoo Jae Doo**

14:10 – 14:15 Discussion

14:15 – 14:25 **Nakamura N:** Current concepts on biotherapy & HTO for OA **Kim Seok Jung/Song Sang Jun**

14:25 – 14:30 Discussion

14:30 – 14:35 Award Ceremony President: **Lee Dong Chul**

Session 9 **Panel Discussion 1**

14:35 – 15:00 HTO complications & abnormal posterior slope (3 cases) **Yoon Jung Ro/ Seon Jong Keun**
Presentor **Lee Yong Seuk**

Lee Bum Sik, Han Hyuk Soo, Kim Man Soo, Matsushita T

15:00 – 15:30 Coffee break or HTO workshop **Sawaguchi T/Park Yong Jee**
Lee Jin Kyu, Kim Gi Beom, Park Sang Hoon, Choi Won Kee

Session 10 HTO or DFO complications **Kyung Hee Soo/Kuriyama S**

15:30 – 15:35 Can status of superficial medial collateral ligament proximal tibial attachment predict progression of OA knee? **Jung WH, Sanchit Roy, Takeuchi R** (Murup Hospital)

15:35 – 15:40 Type III lateral hinge fractures can be caused by forcible opening of insufficient posterior osteotomy during open-wedge HTO

Kuriyama S, Morita Y, Nakamura S, Nishitani K, Matsuda S (Kyoto Univ)

15:40 – 15:45 Delayed bone union resulted in slower recovery of knee extensor muscle strength in MOWDTO
Hiramatsu K, Yamasaki N, Fukumura R, Yamada Y, Nakamura N, Mitsuoka T, Tamai N (Tamai Hospital)

15:45 – 15:50 Incidence and Risk Factors for Lateral Hinge Fractures in Medial Opening Wedge HTO and Medial Opening Wedge Distal Tibial Tuberosity Osteotomy
Hori S, Ogawa H, Nakamura Y, Ichikawa K, Ota, Y, Akiyama H (Gifu Univ)

15:50 – 16:00 Discussion

Session 11 HTO & DFO Biomechanics **Choi Chong Hyuk/Kim Jin Goo**

16:00 – 16:05 Implant Removal After Medial Opening Wedge HTO Provides Implant-Related Pain Relief and Functional Improvement **Song SY** (Hallym Univ)

16:05 – 16:10 A case of unintended valgus malalignment after distal femoral derotational osteotomy in a patient with recurrent patella dislocation : How to prevent it?
Kim HK, Cho MS, Jang SJ, Lee HM, Park JS, Kim TW, Chang MJ, Kang SB (Seoul National Univ)

16:10 – 16:15 Mono-plane medial closing wedge distal femoral osteotomy with condylar hinge is a feasible surgical method to reduce hinge fractures
Matsushita T, Nishida K, Tanaka A, Sano S, Nakanishi Y, Nagai K, Hoshino Y, Kuroda R (Kobe Univ)

16:15 – 16:20 The Biomechanical Comparison of Hinge Fracture between Single-plane and Bi-plane Medial Closing DFO Using Finite Element Analysis (FEM)
Tanaka A, Matsuhita T, Nishida K, Nakanishi Y, Nagai K, Hoshino Y,Nakatsuji T, Katsui Y, Mukai T, Kuroda R (Kobe Univ)

16:20 – 16:30 Discussion

Session 12 Miscellaneous **Lim Hong Chul/Kang Seung Baik**

16:30 – 16:35 Particulated Costal Hyaline Cartilage Allograft With Subchondral Drilling Improves Joint Space Width and Second-Look Macroscopic Articular Cartilage Scores Compared With Subchondral Drilling Alone in Medial Open-Wedge HTO **Shon OJ, Kim GB** (Yeungnam Univ)

16:35 – 16:40 The clinical effect of medial meniscus root tear with repair using all-inside meniscal repair device after open wedge HTO **Kim HJ, Kyung HS** (Kyungpook National Univ)

16:40 – 16:45 Preoperative Hindfoot Alignment and Outcomes After HTO for Varus Knee Osteoarthritis: We Walk on Our Heel, Not Our Ankle
Yang HY, Seon JK, Park CJ, Cheon JH, Jeong WJ (Chonnam National Univ)

16:45 – 16:50 Abnormal Branching of the Anterior Tibial Artery

Harada T (Yokohama Sekishinkai Hospital)

16:50 – 17:00 Discussion

Session Final Panel Discussion 2

17:00 – 17:15 HTO lateral hinge Fx & TKA revison after HTO (2 cases) **Kim Kang Il/ Sohn Oog Jin**
Presentor **Bae Ji Hoon**
Jang Ki Mo, Chang Moon Jong, Kim Hee June, Ogawa H

17:15 – 17:30 HTO infection & HTO Cx (2 cases) **Kim Sung Jung/Jung Woon hwa**
Presentor **Bae Ki Cheor**
Kim Young Mo, Kim Jae Gyoon, Lee Sang Hak, Japan

17:30 – 17:45 DFO Cx & patella instability & G. valgum (2 cases) **Ha Chul Won/Lee Han Jun**
Presentor **Han Jae Hwi**
Lee Dae Hee ,Kim Sung Hwan, Kim Dong Hwi, , Tensho K

17:45 – 18: 00 Best paper award (Korea 1 & Japan 1) President Lee Dong Chul

Booth draw (7개)

18:00 – 18:10 Closing remarks President Lee DC / President Japan

Session 1 **High Tibial Osteotomy 1** **Bae Dae Kyung/Akamatsu Y**

Knee Joint Line Obliquity With Adaptational Hip and Ankle Joint Orientation After Medial Open Wedge High Tibial Osteotomy

Lee Dae Hee, MD, PhD

Investigation performed at Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea

Background: Time-dependent postoperative changes in knee joint line obliquity (KJLO) and subsequent adaptational changes in the hip and ankle joints have not been fully proven after medial open wedge high tibial osteotomy (MOWHTO).

Purpose: To investigate the serial postoperative changes in KJLO and subsequent adaptational changes in the hip and ankle joints over time after MOWHTO.

Study design: Case series, Level of evidence, 4.

Methods: A total of 92 patients who underwent MOWHTO between April 2015 and December 2020 were evaluated. Radiographic parameters, including KJLO, ankle joint line obliquity (ALO), hip abduction angle (HAA), joint line convergence angle, weightbearing line ratio, and hip-knee-ankle angle, were analyzed in time sequence (preoperatively and 3, 6, 12, and 24 months postoperatively). Repeated-measures analysis of variance and post hoc analysis were used to demonstrate alterations and the statistical significance of KJLO and other related radiographic parameters over time.

Results: The mean KJLO values were–1.9,–2.1,–2.7, and–3.2 at 3, 6, 12, and 24 months postoperatively, respectively, indicating that there was consistent increase in valgus tilting of KJLO from 6 to 24 months (P₩.001 for both 6-12 months and 12-24 months). ALO and HAA showed significant changes from 6 to 12 months (ALO, P₩.001; HAA, P = .002), but not between 12 and 24 months (ALO:–3.0,–2.7,–1.9, and 21.6; HAA:–0.8,–0.9,–1.5, and 21.8 at 3, 6, 12, and 24 months, respectively). The mean joint line convergence angle, weightbearing line ratio, and hip-knee-ankle angle did not change significantly from 3 months to 24 months postoperatively.

Conclusion: There was a consistent increase in valgus tilting of the postoperative KJLO from 6 to 24 months after MOWHTO. The adaptive ALO and HAA significantly changed between 6 and 12 months and were maintained until 24 months after MOWHTO. It is necessary to consider the adaptive change when hip or ankle surgery is planned within this period

Title : Lateral Distance From the Osteotomy Hinge Point to the Tibial Cortex Is Associated With Lateral Hinge Fracture Type and Fracture Occurrence Time After Medial Open-Wedge High Tibial Osteotomy

Yang DG, Lee BS(Asan Medical Center)

Purpose: To verify whether the distance from the hinge point to the tibial cortex affects the occurrence time and characteristics of the lateral hinge fracture (LHF) in medial open-wedge high tibial osteotomy.

Methods: We retrospectively reviewed 171 knees in 171 patients (121 women, 50 men; mean age, 53.9 years; range, 36-67 years) who had undergone medial open-wedge high tibial osteotomy with locking plate fixation between January 2011 and December 2020. Osteotomy hinge point and LHFs were identified on intraoperative fluoroscopy and immediate postoperative radiographs. LHF type was classified as suggested by Takeuchi et al. Acute fracture was defined as a fracture that occurred during surgery, and delayed fracture was defined as a fracture observed after 1 month postoperatively. The nearest distances from osteotomy hinge point to lateral, distal, and proximal cortex were measured on postoperative radiographs. We compared the distance between the different types and between acute and delayed LHFs.

Results: There were 55 LHFs (32%) (type I, 40 knees; type II, 14 knees; type III, 1 knee) that occurred acutely in 41 knees and were found as delayed fractures in 14 knees. The patient demographics were not significantly different between non-LHFs and each type of LHFs. Proximal and distal distances were not statistically different among fracture types and between occurrence times. However, lateral distances were significantly shorter in type I LHFs (6.2 ± 1.8 mm) and longer in type II LHFs (9.3 ± 2.3 mm) than in non-LHFs (7.1 ± 2.7 mm) (P ¼ .020 and .004, respectively). The lateral cortical distances were also different between acute LHFs (6.4 ± 1.9 mm) and delayed LHF (9.0 ± 2.7 mm) (P<.001). In the case of fracture type, the frequency of type I decreases with increase in the lateral distance, whereas that of type II increases with increase in the lateral cortical distance. In acute fracture, type I was dominant (85.4%), whereas in delayed fracture, type II was dominant (57.2%).

Conclusions: The lateral cortical distance from the hinge point was significantly associated with LHF occurrence. Shorter distance increased the risk for acute type I LHF, whereas longer distance increased the risk for delayed type II LHFs.

Level of Evidence: Level III, retrospective comparative prognostic trial.

Linear mixed modeling on the effects of varus knee surgery on the ankle joint weight-bearing axis

Kwon SS, Yoo JD, Lee SY(Ewha Womans Univ)

Background: Varus knee correction may affect the ankle and subtalar joints and impact the prognosis of ankle arthritis because the weight-bearing load on the lower extremity extends from the hip to the foot. We aimed to evaluate the changes in the mechanical axis and the weight-bearing axis of the ankle after varus knee surgery.

Methods: Patients with a varus knee were followed up after undergoing high tibial osteotomy or total knee replacement arthroplasty. The inclusion criteria were age (>18 years) and a history of preoperative and postoperative scanograms. The postoperative change to the ankle joint axis point on the mechanical axis and weight-bearing axis according to the hip-knee-ankle angle correction was adjusted by multiple factors using a linear mixed model.

Results: Overall, 257 limbs from 198 patients were evaluated. The linear mixed model showed that the change in the ankle joint axis point on the mechanical axis was not statistically significant after high tibial osteotomy and total knee replacement arthroplasty ($p = 0.223$). The ankle joint axis point on the weight-bearing axis moved laterally by 0.9% per degree of postoperative hip-knee-ankle angle decrease ($p < 0.001$).

Conclusions: Varus knee correction could affect the subtalar joint and the ankle joint. Our findings require consideration when utilized during pre- and postoperative evaluations using the weightbearing axis of patients undergoing varus knee correction.

Analysis of radiographic factors affecting the significant differences in knee alignment between hip-to-talus and hip-to-calcaneus radiographs after opening-wedge high tibial osteotomy

Park HJ, Suh DH, Kim JG (Korea Univ)

Background: Optimal alignment after opening-wedge high tibial osteotomy (OWHTO) is crucial for obtaining good clinical results. A hip-to-calcaneus radiograph (HCR) appears to reflect the true mechanical axis. However, no study has been reported using the HCR in patients who underwent OWHTO. We aimed to analyze the radiographic factors affecting the significant difference in the weight-bearing line (WBL) ratio between two radiographs after opening-wedge high tibial osteotomy (OWHTO).

Methods: This retrospective study included 51 patients who underwent both hip-to-talus radiographs (HTR) and HCR after OWHTO. The patients were divided into two groups; a consistent group (WBL ratio difference between postoperative HTR and HCR < 5%; N = 35) and an inconsistent group (> 5%; N = 16). Radiographic variables for lower extremity alignment, knee and ankle joints, and clinical scores were evaluated. The receiver operating characteristic curve was used to determine the threshold of radiographic variables that induced inconsistencies between the two radiographs.

Results: The mean postoperative WBL ratio in the HCR of the inconsistent group was significantly higher than that of the consistent group (57.7 ± 13.2% and 49.1 ± 11.6%, respectively) (P = 0.02). The preoperative and postoperative ankle joint line obliquity (AJLO) and preoperative lateral distal tibia ground surface angle (LDTGA) were significantly different between the two groups (P < 0.05). The preoperative AJLO (odds ratio 0.784, confidence interval 0.655 – 0.939, P = 0.008) significantly affected WBL ratio inconsistency. The cutoff value of the preoperative AJLO was 3.16°. However, clinical scores did not differ significantly between the two groups.

Conclusion: The pre-and postoperative AJLO and the preoperative LDTGA were significantly different between the two groups. Among these variables, only preoperative AJLO negatively affected the inconsistency in WBL ratios between the two radiographs (HTT and HTC). Therefore, it should be considered to prevent postoperative overcorrection of the true mechanical axis after OWHTO, even though we corrected it properly.

Session 2 **High Tibial Osteotomy 2** **Kim Sung Jae/Akiyama T**

Transverse osteotomy could get closer to the posterior tibial articular surface in patients with steep posterior tibial slope in OWDTO

Nakamura Y (Gifu Univ)

Purpose

In OWDTO, a transverse osteotomy is performed orthogonal to a descending osteotomy of the tibial tuberosity in sagittal plane, aiming at the tip of the fibular head in coronal plane. However, in this technique, a cutting line of transverse osteotomy could be close to the articular surface of the lateral tibial condyle. The purpose of this study is to investigate the distance from the tip of the fibular head to the articular surface of the lateral tibial condyle.

Methods

Sixteen patients who underwent OWDTO between May 2022 and October 2024 at our institution were included. In patients who underwent unilateral surgery, contralateral sides were also investigated (n=32). The distances from the anterior and posterior margins of the lateral tibial condyle to the perpendicular line from the tip of the fibular head to the anterior cortex of the proximal tibia (anterior and posterior height of the fibular head; AH and PH) were measured on the sagittal plane of preoperative CT scans. The difference between AH and PH was calculated (AH-PH). Posterior tibial slope of the lateral condyle based on the anterior cortex of the tibial diaphysis (lPTS) was measured. Correlation between lPTS and AH, PH, and AH-PH was analyzed.

Results

The mean AH, PH, and AH-PH were 11.9 (6.0-15.3) mm, 8.6 (2.1-12.3) mm, and 3.3 (0-9.2) mm, respectively. The lPTS was significantly correlated with PH ($r = -0.37$, $p = 0.04$) and AH-PH ($r = 0.88$, $p < 0.01$).

Conclusion

The steeper lPTS becomes, the closer to the articular surface the tip of the fibular head gets. Because the fibula height is seen lower in the case with steep PTS, the risk of articular cartilage injury by osteotomy may increase in such cases. Surgeons should take this result into account to decide transvers osteotomy line.

Factors associated with the progression of cartilage degeneration in the patellofemoral joint after opening wedge high tibial osteotomy

Mikami D, Kumagai K, Akamatsu T, Inaba Y(Yokohama City Univ)

Purpose: Progression of cartilage degeneration in the patellofemoral (PF) joint is a potential complication following medial opening wedge high tibial osteotomy (OWHTO). Although patellar baja due to the distal shift of the tibial tuberosity has been reported as a potential cause, the relationship between lateralization of the tibial tubercle and cartilage degeneration remains unclear. This study aimed to investigate the factors associated with the progression of cartilage degeneration in PF joint after OWHTO. We hypothesis that these factors include the lateralization of the tibial tubercle, which is presented as tibial tubercle-trochlear groove (TT-TG) distance and tibial tubercle-posterior cruciate ligament (TT-PCL) distance.

Methods: This retrospective study included 49 knees of 37 patients with medial compartment osteoarthritis of the knee (mean age 67 years; 24 males and 25 females) who underwent OWHTO. Cartilage status was assessed by arthroscopy at the time of OWHTO (first-look) and at the time of implant removal (second-look), and ICRS grade was recorded. The patients were divided into two groups based on the cartilage status of the PF joint at the second-look: the deteriorated group and the unchanged/improved group. The difference between the groups was assessed in age, gender, BMI, correction angle, opening gap, modified Caton-Deschamps index (mCDI), modified Blackburne-Peel ratio (mBPR), TT-TG distance and TT-PCL distance. Logistic regression analysis was used to identify factors associated with cartilage deterioration.

Results: Fifteen knees were classified into the deteriorated group, and 34 knees into the unchanged/improved group. The deteriorated group had significantly greater preoperative TT-TG distance (15.5 mm vs. 11.9 mm, $P<0.05$), postoperative TT-TG distance (14.9 mm vs. 10.4 mm, $P<0.05$), preoperative TT-PCL distance (23.0 mm vs. 20.1 mm, $P<0.05$), and postoperative TT-PCL distance (24.0 mm vs. 20.3 mm, $P<0.05$) than unchanged/improved group. No significant differences were found between the groups in terms of age (70 years vs. 66.2 years), gender distribution (6:9 vs. 18:16), BMI (25.4 kg/m2 vs. 26.8 kg/m2), correction angle (12.7° vs. 12.0°), opening gap (12.9 mm vs. 13.0 mm), preoperative mCDI (0.96 vs 0.99), postoperative mCDI (0.78 vs 0.78), preoperative mBPR (0.92 vs 0.94) or postoperative mBPR (0.72 vs 0.73). Logistic regression analysis revealed that postoperative TT-TG distance was significantly associated with progression of the cartilage degeneration in the PF joint ($B=0.484$, $SE=0.167$, $P=0.004$, $\beta=1.623$).

Conclusion: Postoperative TT-TG distance is a factor associated with the progression of cartilage degeneration in the PF joint after OWHTO.

Return to play after H-CWHTO (Hybrid closed wedge high tibial osteotomy)

Shimakawa T(Yaese-kai Doujin hospital)

Purpose

There are many reports on return to sports after knee osteotomy, and the rate of return to sports after open wedge high tibial osteotomy (OWHTO) is particularly high. On the other hand, hybrid CWHTO (H-CWHTO), a variant of closed wedge high tibial osteotomy (CWHTO) indicated for more advanced knee osteoarthritis, has shown good results, but there are no reports on return to sports after surgery. Therefore, we report here the return to sports at 2 years after surgery.

Methods

In a retrospective cohort study, patients underwent radiographic evaluation before and after surgery and were asked questions using a questionnaire at 2 years postoperatively.

Results

Thirty-one patients with 39 knees were included in the study, with a preoperative Tegner activity score (all median values below) of 3.9, K-L grade 2.6, %MA 18.1%, mMPTA 83°, and age 63.1 years. Twenty-two patients (71%) continued to play sports 2 years after surgery as they did before surgery.

Conclusion: Return to sports after H-CWHTO surgery, which is indicated when arthropathic changes have progressed, may be expected to be adequate.

Double Level Osteotomy Provides Satisfactory Mid-term Outcomes for Symptomatic Severe Varus Osteoarthritic Knees.

Ueshima R, Onishi S, Iseki T, Kanto R, Gejo R, Yoshiya S, Tachibana T, Nakayama H (Nishinomiya Kaisei Hospital)

【Objectives】Double level osteotomy (DLO) is indicated for symptomatic severe varus osteoarthritic (OA) knees with the intent of restoring physiologic joint alignment and bony geometry. Although satisfactory short-term outcomes of this procedure have been reported, there is a paucity of information regarding its mid-term clinical outcomes. Therefore, the purpose of this study was to examine the mid-term outcomes following DLO and analyze the relationship between the radiological and clinical outcomes.

【Method】This retrospective study was composed of a consecutive series of 26 patients (36 knees) with a mean age of 62.4 years (range, 52-75) who underwent DLO for severe varus OA knees. All patients could be followed up for a minimum of 5 years. DLO was adopted when there were combined varus deformities both in the distal femur and proximal tibia, and the postoperative hip-knee-ankle angle (HKAA) was aimed at +1° valgus. Clinical outcomes were assessed using the Knee Injury and Osteoarthritis Outcome Score (KOOS), while radiological parameters including lateral distal femoral angle, medial proximal tibial angle, joint line convergence angle (JLCA) and HKAA were measured in the radiological evaluation. In the data analysis, the influences of pre- and postoperative geometric parameter values on the radiological and clinical outcomes as well as the relationship between the radiological and clinical outcomes at the follow-up were statistically assessed.

【Results】Clinical score using the KOOS was significantly improved from 190 ± 76 before surgery to 393 ± 78 at 2 years and the clinical improvement had been maintained at 5 years (384 ± 78). Radiological evaluation showed that the HKAA was corrected from -13.2° ± 3.0° varus to -0.4° ± 3.1° varus at 2 years, which indicated under-correction as compared to the intended value. Thereafter, a small amount of varus recurrence was observed at 5 years with the mean HKAA decreased by 1.2° ± 3.6°. While JLCA was decreased from 6.2° ± 2.4° preoperatively to 3.7° ± 1.9° at 2 years, the value measured at 5 years increased again to 4.8° ± 2.1°. When the study subjects were divided into the under-corrected group with the HKAA of less than -2° (n=15, 41.7 %) and the other group of the remaining knees (n=21), the mean KOOS score in the former group was significantly lower than that in the latter group (342 ± 91 vs 413 ± 51, $p<0.01$).

【Conclusions】The present study results with mid-term follow-up evaluation showed slight under-correction and small amount of recurrence of bone/joint deformity over time; however, postoperative clinical improvement was maintained until 5 years. Analysis of the relationship

between the radiological and clinical outcomes showed that the clinical outcomes were significant inferior in the under-corrected group exhibiting residual varus.

Session 3　　Special Japan lecture 1

My surgical Technique of Distal Femoral Osteotomy

Ryohei Takeuchi MD

Joint Surgery Center, Yokohama Sekishinkai Hospital

The distal femoral osteotomy (DFO) is a surgical procedure performed for valgus knee deformities associated with lateral-joint osteoarthritis of the knee or in cases of double-level osteotomy. Key considerations during surgery include the prevention of popliteal artery injury, hinge fracture, and ensuring strong fixation at the osteotomy site.

We have developed a specialized retractor to enhance the safety of this procedure and will discuss its usefulness. Additionally, the double plate technique is recommended to enable early postoperative rehabilitation. This involves placing a small plate anterior to the main plate, using the same surgical incision for the approach. This technique increases the fixation strength of the osteotomy site, allowing for active range-of-motion exercises and full weight-bearing training starting one week after surgery, thereby shortening the time required for bone union. I will present outline a safe and reliable surgical approach.

Inverted V-shaped high tibial osteotomy

Eiji Kondo, MD, PhD

Professor, Centre for Sports Medicine, Hokkaido University Hospital, Sapporo, Hokkaido

Inverted V-shaped high tibial osteotomy (iV-HTO) is classified as a neutral (hemi-closing and hemi-opening) wedge osteotomy. Namely, in this procedure, the center of tibial alignment correction (hinge point) of the HTO is located approximately at the center of rotation of angulation (CORA) of the lower limb deformity. According to the principle of the bone deformity correction, it is expected that this procedure does not affect the patellar height, tibial length, or bone mass of the tibial plateau. The first clinical outcome of the iV-HTO, in which an external fixator was used to fix the osteotomized tibia, was reported by Aoki et al (J Bone Joint Surg-Br 2006). They stated that the 10-year follow-up results were significantly better than for the closed wedge HTO. Yet, this procedure had a few disadvantages. First, it was technically difficult for surgeons to precisely perform the iV osteotomy. Second, 10 to 12 weeks were needed to allow for weight-bearing after surgery. To solve these disadvantages, we recently modified the original procedure by developing cutting guide devices to precisely perform the biplanar osteotomy and a locking plate system for lateral tibial fixation (Arthrosc Tech 2018). Recently, we conducted a comparative study to compare the influence of HTO on the patellofemoral (PF) joint and the tibial dimensions between the iV-HTO and medial open wedge (OW) HTO procedures (Am J Sports Med 2022). Patellar height, posterior tibial slope, and tibial length did not change after the iV-HTO, while they were significantly changed after the OW-HTO. Although the preoperative degrees of varus knee and PF osteoarthritis were more severe in the iV group than the OW group, the iV-HTO led to altered PF joint congruity. In this symposium, we would like to show the surgical technique of iV-HTO with acute oblique fibula osteotomy and ligation procedure (Arthrosc Tech 2020, Orthop J Sports Med 2022).

Detection of Lateral Hinge Fractures After Medial Closing Wedge Distal Femoral Osteotomy

Kim SG(National Medical Center) Nha KW(Inje Univ)

Background: Limited evidence exists in the literature regarding the detection rates of lateral hinge fracture (LHF) on computed tomography (CT) after medial closing wedge distal femoral osteotomy (MCDFO). Moreover, the effect of LHF on bone healing after MCDFO remains unclear.

Hypothesis: The detection rates of LHF after MCDFO would be higher on CT than on plain radiography. The incidence of problematic bone healing would be higher in the knees with than in those without LHF.

Study Design: Cohort Study (Diagnosis), Level 3

Methods: Patients who underwent MCDFO between May 2009 and July 2019 were retrospectively evaluated. The presence of LHF was evaluated using immediate postoperative plain radiography and CT. The detection rates of LHF on plain radiography and CT were compared. The incidence of problematic bone healing (nonunion, delayed union, and loss of correction) was also compared between the knees with and those without LHF.

Results: Fifty-five knees of 43 patients (mean age, 37.7±16.7 years) were included in the study. Although 33 LHFs were detected on CT, only 19 LHFs were detected on plain radiography. The detection rates of LHF was significantly higher on CT than on plain radiography (60.0% vs. 34.5%; p=0.008). At 1-year follow-up, 10 cases of problematic bone healing (1 nonunion, 4 delayed union, and 5 loss of correction) were identified. The incidence of problematic bone healing was significantly higher in the knees with LHF than in those without LHF on plain radiography (36.8% vs. 8.3%; p=0.001) and CT (30.3% vs. 0%; p=0.004).

Comparative analysis of gait: Similar coronal but different sagittal effects between closing-wedge and opening-wedge high tibial osteotomy

Lee DH, Han HS, Ro DH(Dongguk Univ)

Purpose: High tibial osteotomy is an established surgical option for medial compartment osteoarthritis of the knee with varus alignment. It can be divided into open wedge and closing wedge by operative technique. Although they have fundamental differences, little is known about the biomechanical consequences of the two surgical methods.

Methods: Thirty-eight patients with medial compartment osteoarthritis who underwent high tibial osteotomy (19 open-wedge and 19 closing-wedge) were retrospectively reviewed. Clinical scores and radiological measurements were assessed until postoperative two years. Gait analysis was performed preoperatively and again at postoperative one year.

Results: Varus alignment was corrected in both groups without a significant difference between them ($p = 0.543$). However, posterior tibial slope was higher, and the Blackburne-Peel ratio was lower in the open wedge osteotomy group after surgery (both $p < 0.001$). Reduction of dynamic knee varus and knee adduction moment were observed in both groups without significant differences. However, after surgery, average knee range of motion (63.3° vs 57.3°, $p < 0.001$) and the magnitude of knee flexion moment was significantly lower ($p = 0.005$) in the closing wedge group. There were no significant differences in the Kujala Anterior Knee Pain Scale and the occurrence of patellofemoral arthritis between the groups postoperatively.

Conclusion: After osteotomy, a smaller average knee range of motion in the sagittal plane and a higher knee flexion moment were observed in the open wedge osteotomy group, suggesting quadriceps muscle avoidance. However, no differences in clinical scores or the short-term occurrence of patellofemoral arthritis were noted between the two surgical techniques.

The impact of fluoroscopic tilt angle on the appearance of the hinge region in medial closing wedge distal femoral osteotomy

Nakanishi Y, Hoshino Y, Matsushita T, Kuroda R, Nishida K (Kobe Univ)

Introduction: In Medial Closed Wedge Distal Femoral Osteotomy (MCWDFO), it is important to place the hinge in the appropriate position to avoid hinge fracture. Intraoperative fluoroscopy is often used to confirm the hingeposition during MCWDFO. However, there are cases where surgeons struggle with visualizing the hinge position and need to adjust the fluoroscopic tilt angle to achieve an appropriate image. There have been no reports on the relationship between the appearance of the hinge region and the fluoroscopic tilt angle. This study aims to examine how the appearance of the hinge region changes with variations in fluoroscopic tilt angle (cephalad and caudal tilts) during MCWDFO.

Methods: Nine knees undergoing MCWDFO were included in this study. Fluoroscopic images were obtained under anesthesia, with the knee in an extended position and neutral rotation (0°). Then, fluoroscopy was tilted at different angles: cephalad tilts of 2.5°, 5°, and 10°, as well as caudad tilts of 2.5°, 5°, and 10°. A total of 7 images were obtained. To define the hinge region, three reference lines were drawn: (A) A tangent at the proximal edge of the medial and lateral condyles of the femur, (B) A line drawn from the cortex 35 mm proximal to the inflection point of the medial distal femur to the lateral condyle of the femur, (C) A line connecting the intersections of lines A and B with the lateral femoral cortex. The area enclosed by line(A) (B) and (C) was approximated as the hinge region. The area (mm^2) was calculated for each fluoroscopic image using a software (Image J), and the results were compared across different tilt angles.

Results:The hinge region area (mm^2) for each fluoroscopic tilt angle were as follows: Cephalad10: 18.6, Cephalad5: 23.3, Cephalad2.5: 30.7, Cephalad-Caudal0: 40.4, Caudal2.5: 41.5, Caudal5: 45.7 and Caudal10: 48.9. The area in the Cephalad10 was significantly smaller than Cephalad-Caudal0, Caudal 2.5, Caudal5 and Caudal10.

Conclusion: The results suggest that when fluoroscopy is tilted cephalad, the hinge region appears smaller, which could interfere with determining optimal hinge position. Surgeons should pay attention to the fluoroscopic tilting angles during surgery to ensure optimal appearance of the hinge region.

Tibial axis inclination nearly become vertical to the ground up 24 months after double level osteotomy

Kobayashi H, Akamatsu Y (Fureai Yokohama Hospital

Purpose: To investigate change in femoral and tibial axis to the ground after double level osteotomy (DLO) measured up to 24 months.

Methods: Overall, 74 knees (mean age: 62 years, female: 56, male: 18) treated with DLO were enrolled. Several angles using whole single-leg radiographs were assessed preoperatively and up to 24 months postoperatively. Hip knee ankle angle (HKA), weight-bearing line (WBL) ratio, knee joint line obliquity (KJLO), and ankle joint line obliquity (AJLO) were measured. Minor angles of femoral and tibial axis to the ground were defined as femoral axis inclination (FAI) and tibial axis inclination (TAI).

Results: Preoperative HKA of -10.6° and WBL ratio of 3.2% were corrected to 2.9° and 60.0% at 24 months after DLO, respectively (all of $p < 0.01$). Preoperative FAI of 2.4°, TAI of -6.9°, KJLO of 0.7°, and AJLO of 9.9° changed to 9.0°, 1.6°, -2.1° and 0. 9° at 6 months after DLO, respectively. TAI increased by -2.1°, -1.1° and -0.6° at 6, 12 and 24 months postoperatively, respectively. AJLO increased by 0.9°, 2.6° and 3.4° at 3, 6, 12 and 24 months postoperatively, respectively.

Conclusion: TAI changed to be almost vertical to the ground up to 24 months after DLO. Postoperative verticality of TAI might be related to stable walking.

Session 5 **HTO & PF Joint** **Suh Jeung Tak/Ogawa H**

Retro-tubercular Osteotomy Is More Favorable on Three-Dimensional PF joint Alignment than Supra-tubercular Osteotomy

Cho JH, Jade Pei Yuik Ho, Nguyen Thanh Tu, Lee YS(Seoul National Univ)

Background: After bi-planar medial opening wedge high tibial osteotomy (OWHTO), unintended changes in patellofemoral (PF) joint alignment may occur; this can affect the biomechanics of the PF joint. Bi-planar (OWHTO) can be performed as supra-tubercular (ST-OWHTO) or retro-tubercular (RT-OWHTO) osteotomy technique, depending on the direction of the second plane osteotomy (Figure 1). This study aimed to compare the changes in PF joint alignment, focusing on the three-dimensional planes, between two different types of bi-planar OWHTO.

Methods: Patients who underwent bi-planar OWHTO between July 2017 and May 2021 were retrospectively evaluated. They were allocated to two groups (ST-OWHTO and RT-OWHTO groups). Radiologic evaluations were performed using plain knee radiographs, preoperative magnetic resonance imaging (MRI), and postoperative computed tomography (CT) scans. All radiographs and CT scans used for postoperative evaluation were obtained 2 days after OWHTO. For assessment of bi-dimensional alignment, (1) weight- bearing line ratio (WBLR), (2) patellar height, (3) patellar tilt angle (PTA), and (4) posterior tibial slope (PTS) were evaluated. For assessment of three-dimensional PF joint alignment, (1) tibial tuberosity-trochlear groove (TT-TG) distance, (2) TT-TG angle, and (3) femoral shaft-patellar tendon (FS-PT) angle were evaluated (Figure 2). Clinical outcomes were assessed before and 1 year after the operation using the American Knee Society Score and the Western Ontario and McMaster Universities Osteoarthritis Index. All these evaluations were compared between the two groups.

Results: In total, ST-OWHTO in 104 knees and RT-OWHTO in 105 knees were enrolled. The change in WBLR was not different between both groups ($p=0.987$). Patellar height significantly decreased only after ST-OWHTO as shown by change in Blackburne-Peel (-0.13 ± 0.13; $p < 0.001$) and Caton-Deschamps (-0.12 ± 0.18; $p < 0.001$) ratios, whereas it did not change after RT-OWHTO. PTA decreased in both the ST-OWHTO (-1.67 ± 1.77; $p < 0.001$) and RT-OWHTO (-1.70 ± 2.25; $p < 0.001$) groups, and the difference was not statistically significant ($p = 0.920$). PTS increased more after RT-OWHTO as shown by change in PTS (0.91 ± 2.05 versus 1.69 ± 1.78; $p = 0.004$). The TT-TG distance and FS-PT angle increased in both ST- and RT-OWHTO groups. However, the changes were significantly larger after ST-OWHTO compared with RT-OWHTO (5.72 ± 3.38 versus 1.91 ± 3.57; $p < 0.001$ for TT-TG distance, 4.72 ± 3.18 versus 1.80 ± 3.17; $p < 0.001$ for FS-PT angle, respectively). The TT-TG angle increased significantly after ST-OWHTO (7.62 ± 6.64; $p < 0.001$) but decreased after RT-OWHTO (-4.30 ± 6.69; $p < 0.001$) (Figure 3). Clinical outcomes did not differ between the groups.

Conclusion: RT-OWHTO produced more favorable three-dimensional PF joint alignment compared with ST-OWHTO. Although, there was no difference in clinical outcomes in short term follow-up, RT-OWHTO can be recommended in cases with concerns regarding the PF joint during OWHTO.

Patellofemoral Cartilage Degeneration After Closed- and Open-Wedge High Tibial Osteotomy With Large Alignment Correction

Song SJ, Yoon KH, Park CH(Kyung Hee Univ)

Background: Previous studies have reported patellofemoral cartilage degeneration and analyzed the factors affecting degeneration after OWHTO. However, no studies have evaluated patellofemoral cartilage degeneration or examined the factors affecting degeneration after closed(CWHTO).

Purpose: To investigate and compare patellofemoral cartilage degeneration after CWHTO and OWHTO via arthroscopic evaluation and to analyze the factors affecting the degeneration.

Methods: A total of 54 CWHTOs and 50 OWHTOs were performed with first-look arthroscopy between 2013 and 2017 at one institution. Hardware removal and second-look arthroscopy were performed, on average, 30.2 months after CWHTO and 26.8 months after OWHTO (P = .178). Patient characteristics did not differ significantly between the groups. Radiographically, the mechanical axis, posterior tibial slope, and modified Blackburne-Peel ratio were evaluated. Arthroscopically, the percentage of patient with patellofemoral cartilage degeneration was evaluated according to the International Cartilage Repair Society grading system. Logistic regression analysis was used to identify the factors affecting patellofemoral cartilage degeneration in terms of demographics and the change of mechanical axis (correction angle), tibial posterior slope angle, and modified Blackburne-Peel ratio. The Anterior Knee Pain Scale was used for clinical comparison between the patellofemoral degenerative and nondegenerative groups.

Results: No significant differences were observed in pre- and postoperative radiographic results between the CWHTO and OWHTO groups, except that the postoperative modified Blackburne-Peel ratio was significantly smaller among the OWHTOs. The percentage of patients with patellofemoral cartilage degeneration were 29.6% in the CWHTO group and 44% in the OWHTO group (P = .156) at second-look arthroscopy. The correction angle was the only significant factor affecting cartilage degeneration in the CWHTO group (odds ratio, 2.324; P = .013; cutoff value, 9.6°) and the OWHTO group (odds ratio, 1.440; P = .041; cutoff value, 10.1°). The postoperative Anterior Knee Pain Scale score was significantly lower in the patellofemoral degenerative group as compared with the nondegenerative group among the OWHTO group (81.6 vs 76.4; P = .039); among the CWHTO group, there was a lower tendency in the degenerative group, but this was without significance (81.1 vs 79.6; P = .367).

Conclusion: Patellofemoral cartilage degeneration progressed after CWHTO and OWHTO with large alignment correction. High tibial osteotomy should be selected with careful consideration of the osteoarthritic status of the patellofemoral joint and required correction angle, regardless of applying a closed- or open-wedge technique.

Infratubercle Slope Reducing Proximal Tibial Osteotomy Can Corrects Sagittal Alignment without Affecting Coronal Alignment and Patellar Height.

Onishi S, Nakayama H, Iseki T, Matthieu Ollivier (Hyogo Medical Univ)

Background/ Purpose: Excessive posterior tibial slope (PTS) has been associated with a higher risk of graft failure after anterior cruciate ligament reconstruction (ACLR). Although slope reducing proximal tibial osteotomy (SRO) can reduce the PTS, it may also change the coronal alignment and patellar height. The aim of this study was to elucidate the radiological outcomes after infratubercle SRO, specifically to evaluate its influence on perioperative changes in patellar height.

Methods: Patients who underwent infratubercle SRO with combined ACLR with a minimum follow-up of 6 months were included. Surgery was indicated when the PTS was greater than 12°. Radiological evaluation included measurements of the hip–knee–ankle angle (HKA), PTS, femoral patellar height index (FPHI), and Caton–Deschamps index (CDI) preoperatively and 3 months postoperatively. Patellar height was classified as patella baja, normal, or alta based on CDI values. Knee recurvatum was measured pre-operatively and at final follow-up.

Results: A total of 21 patients with a mean age of 21.6 ± 3.0 years were included. Although HKA did not significantly change, significant corrections were achieved in the PTS from 14.5° ± 1.6° to 5.7° ± 1.0° ($p < 0.001$). No significant change in FPHI was found (pre-operative: 1.33 ± 0.11 vs postoperative: 1.30 ± 0.09). Patellar height categories showed no significant differences pre- and postoperatively, while three patients (14.3%) changed their patellar height category (all moved up one category). Knee recurvatum increased significantly from 4.9° ± 2.9° pre-operatively to 7.8° ± 3.1° at the final follow-up ($p < 0.001$).

Conclusions: Precise sagittal correction was achieved after infratubercle SRO without altering the coronal alignment and patella height.

Interlocking Open-wedge Distal Tibial Tuberosity Osteotomy: A Stabilizing Technique for the Retro-tubercle without Additional Screw Fixation

Akasaki Y, Horikawa T (Kyushu Univ)

We introduce a new knee osteotomy technique called the Interlocking Open-wedge Distal Tibial Tuberosity Osteotomy (Interlocking OW-DTO). The term 'interlocking' refers to how the repositioned parts of the retro-tubercle fit together perfectly as the transverse osteotomy opens to the desired corrective angle. This unique interlocking feature creates a stable retro-tubercle structure, similar to a mortise-and-tenon joint with the practices of Japanese temple carpenters. The distal end of the tibial tuberosity fits securely behind the tibial diaphysis, increasing stability and aiding the healing process. This effectively prevents poor union of the retro-tubercle caused by widening of the retro-tubercle gap and increased posterior tibial slope. Furthermore, the need for additional hardware, such as antero-posterior screw fixation to secure the retro-tubercle during healing, is eliminated. This simplifies the surgical procedure and reduces potential complications associated with DTO using such hardware. Notably, even in the event of hinge fracture, preferential healing of the retro-tubercle is observable.

Luncheon symposium **Lee Young Kuk**

ResynoOne Injection Kim SG (National Medical Center)

Session 6 High Tibial Osteotomy & Cartilage Han Seung Bum/Ishikawa M

Clinical Benefits of Cartilage Repair in High Tibial Osteotomy Can Only be Expected in Patients with Successfully Regenerated Cartilage.

Jung SH, Jung M, Chung KH, Moon HS, Kim TH, Choi CH, Kim SH (Yeonsei Univ)

Background: The clinical benefits of the additional clinical benefits of combined cartilage procedures performed with high tibial osteotomy (HTO) remains undetermined. This study aims to determine the additional clinical benefits by comparing the combined procedure group with isolated HTO group, stratified by the success of cartilage regeneration.

Methods: Patients who underwent medial open-wedge HTO from 2010 to 2022 with a minimum 2-year follow-up were retrospectively reviewed. Patients were divided into two groups: HTO + combined cartilage procedures (C group) and isolated HTO (I group). C group was further divided into two subgroups based on the medial femoral condyle (MFC) cartilage status assessed on second-look arthroscopy: well-regenerated cartilage (C1 group) and poorly regenerated cartilage (C2 group). Propensity score-matched I groups were formed for each C1 and C2 group (C1-matched, C2-matched group I), based on baseline factors affecting clinical outcomes. Comparative analysis was performed for each matched pair in patient-reported outcomes (PROs).

Results: A total of 313 patients were retrospectively reviewed in this study, with 199 patients included in the analysis (83 patients in the C group [49 in the C1 group, 34 in the C2 group], and 116 patients in the I group). Baseline characteristics showed no significant difference between the matched groups after propensity score matching. The mean follow-up period for all groups was approximately 3 years with no significant differences. The C1 group showed significantly better PROs and improved PROs at final follow-up compared to the C1-matched I group (VAS, $p<0.001$; Lysholm, $p=0.004$; KOOS subscales, $p\leq0.018$). However, the C2 group did not show any differences in PROs compared to the C2-matched I group at final follow-up.

Conclusion: Only patients with well-regenerated cartilage after combined cartilage repair procedures showed additional clinical outcome improvements with HTO. When considering combined cartilage repair procedures with HTO, selecting appropriate candidates for achieving successful cartilage regeneration is necessary to yield additional clinical benefits.

Allogeneic Umbilical Cord Blood-derived Mesenchymal Stem Cell Implantation Combined with High Tibial Osteotomy versus High Tibial Osteotomy Alone for Medial Knee Osteoarthritis with Full-Thickness Cartilage Defects

Park YB, Lee HJ, Kim SH (Chung Ang Univ)

Purpose: Although the effects of cartilage repair in patients undergoing high tibial osteotomy (HTO) remains controversy, cartilage repair may be required for the full-thickness cartilage defect due to concern of lower clinical outcome. The purpose of this study was to investigate clinical outcome and cartilage repair following implantation of allogeneic umbilical cord blood-derived MSCs (UCB-MSCs)·hyaluronate composite in patients who received HTO for medial knee osteoarthritis (OA) with full-thickness cartilage defect.

Methods: Inclusion criteria were patients with a medial knee OA, a full-thickness cartilage defect (International Cartilage Repair Society [ICRS] grade IV) ≥ 2 cm2 of the medial femoral condyle, and a varus deformity ≥ 5°, and with second look arthroscopic evaluation. The full-thickness cartilage defect was treated with implantation of an allogeneic UCB-MSCs·hyaluronate composite or left in situ without procedure following medial open-wedge HTO. Visual analogue scale for pain and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score were assessed at each follow-up. Cartilage repair was assessed by the International Cartilage Repair Society-Cartilage Repair Assessment cartilage repair assessment (ICRS-CRA) grading system and Koshino staging system at second-look arthroscopy when the plate removed.

Results: Thirty seven patients were included: 17 in the UCB-MSCs-HTO group and 20 in the HTO alone group. The mean age 56.7 years and mean defect size: 4.5 cm2 with the final follow-up of mean 4.9 years (range; 1-8 years). All clinical outcomes had improved in both group. At finial follow-up, UCB-MSCs-HTO Group showed significantly improved scores clinical outcomes. UCB-MSCs-HTO Group showed a significantly better cartilage status than the HTO alone group based on the ICRS-CRA grading system and Koshino staging system ($P < 0.05$ and < 0.05, respectively).

Conclusion: Allogeneic UCB-MSCs implantation combined with HTO resulted in favorable clinical outcome and cartilage repair compared with HTO alone. These findings suggest that UCB-MSCs implantation combined with HTO would be a good therapeutic option for patients with medial knee OA and full-thickness cartilage defects.

Short to Mid-term Clinical Outcome of the Iliac Bone Block Graft Combined with the AKO for Patients with Massive Osteochondral Defects at the Weight Bearing Area of the Femoral Condyle

Nakayama S (JR Tokyo General Hospital)

(Purpose) To report short to medium-term results of the iliac bone block graft (IBBG) combined with the around knee osteotomy (AKO) for patients with massive osteochondral defects at the weight bearing area of the femoral condyle.

(Method) From 2014 to 2021, 10 patients who had massive osteochondral defects at the weight bearing area were included. At the surgery, the iliac crest was adapted as a joint surface. Postoperative rehabilitation was performed as same as the conventional AKO. The clinical outcomes (KSS, ROM, KOOS) were compared with 51 knees who had AKO without bone graft. Furthermore, age, BMI, and preoperative FTA matched 10 knees were extracted for the analysis.

(Results) The average defect size was 29.7 mm (AP) x 17.2 mm (ML) x 13.8 mm (depth). The clinical outcomes (mean 64.3 months) were significantly improved and comparable to those of the conventional AKO and matched groups.

(Discussion) Even considering the invasiveness of harvesting the iliac bone, reconstruction of the joint surface shape using this method is a valuable for distributing the load and acquiring joint excursion properties.

(Conclusion) The short to mid-term results of IBBG combined with AKO for patients with massive osteochondral defects at the articular surface were good.

Open-Wedge High Tibial Osoteotomy and Osteochondral Autologous Transfer Surgery for Medial Knee Osteoarthritis With Lateral Femoral Condylar Cartilage Damage: Midterm Outcomes in a Case Series

Yokoyama M (Okayama Kyokuto Hospital)

Purpose Valgic around-knee osteotomy (AKO) is a joint-preserving procedure commonly performed to treat medial knee osteoarthritis (m-KOA) by redistributing load from the medial to the lateral compartment. However, when planning valgic AKO, some patients present with cartilage damage in the lateral femoral condyle (LFC), which can worsen postoperatively due to increased lateral compartment loading. This study evaluates the midterm outcomes of combining medial opening wedge high tibial osteotomy (MOWHTO) with osteochondral autologous transfer surgery (OATS) to address both m-KOA and LFC cartilage damage.

Method Four knees from three female patients aged 59–64 years, with m-KOA and LFC cartilage damage classified as ICRS grade 3C or higher, underwent this combined procedure between July 2014 and July 2016. Exclusion criteria included lateral meniscus or anterior cruciate ligament damage. Radiographic assessments and clinical outcomes were evaluated preoperatively and at 12 months and 72 months postoperatively. Parameters such as femorotibial angle (FTA) and joint line convergence angle (JLCA) were measured, while clinical outcomes were assessed using JOA, Knee Society (KS), and functional scores (FS).

Result The patients had medial osteoarthritis of the knee, classified as grade 3 or 4 according to the K-L classification. The mean preoperative FTA was 182 degrees, and the mean JLCA was 5.1 degrees. The preoperative JOA score was 68.8 points, the KSS was 17.5 points, and the FS was 67.5 points. The mean FTAs were 170.0° at 12 months after surgery and 170.3° at 72 months after surgery. The mean JLCAs were 4.1° at 12 months after surgery and 4.4° at 72 months after surgery. With regard to the clinical outcomes, the mean JOA score was 89.3 points, the mean KS was 90.0 points, and the mean FS was97.9 at 12 months after surgery. Seventy-two months after surgery, the mean JOA score was 88.8 points, the mean KS was97.3 and the mean FS was 97.3.

Conclusion MOWHTO combined with OATS for patients with m-KOA and LFC cartilage damage resulted favorable midterm outcomes, demonstrating the potential to improve surgical success and patient satisfaction. This study underscores the importance of evaluating and treating lateral compartment cartilage damage during valgic AKO to optimize long-term joint preservation and functional outcomes.

Session 7 Open Vs Closed HTO Suh Seung Seok/Kubota M

Difference in Correction Power Between Hybrid Lateral Closed-Wedge High Tibial Osteotomy and Medial Open-Wedge High Tibial Osteotomy was Associated with Severity of Varus Deformity and Different Hinge Distance from Center of Deformity.

Jung SJ, Rhee SJ (Busan National Univ)

Purpose

Hybrid lateral closed wedge high tibial osteotomy (HBHTO) carries certain advantages over medial open wedge high tibial osteotomy (OWHTO). We investigated the potential difference in the required correction angle between HBHTO and OWHTO to achieve an equal amount of whole-lower extremity alignment correction.

Methods

We performed retrospective analysis of one hundred patients' preoperative plain radiographic images. The medial proximal tibial angle(MPTA), joint line convergence angle(JLCA), mechanical lateral distal femoral angle(mLDFA), hip-knee-ankle axis(HKA), length of the tibia, width of the tibial plateau, length of the whole lower limb (leg length), position of weight-bearing-line (WBL) and location of center of deformity (CD) were measured in orthoroentgenogram. Design for virtual HTO using 'Miniaci' method was performed both in HBHTO and OWHTO settings for all the cases. Differences in the required correction angle at the hinge point between the two techniques were compared, and a correlation analysis was performed to reveal the influential factors.

Results

Orthoroentgenograms of 24 men and 76 women (mean age: 63.8 years) were assessed. The mean difference in required correction angle between the two designs (CAD) was 0.78±0.22° ($p<0.001$). The mean WBL change per correction angle was 3.9% in HBHTO and 4.1% in OWHTO ($p<0.001$). The mean difference in distance from the hinge point to CD between HBHTO and OWHTO was 16.35±4.74mm ($p<0.001$). Correlation analysis revealed a strong positive correlation between CAD and HKA. mLDFA, JLCA, MPTA, and leg length showed significant correlation with CAD.

Conclusion

HBHTO required a 5.6% larger correction angle at the hinge point to achieve the same amount of alignment correction as OWHTO. The difference in the correction angle between the two techniques tend to increase in patient with severe deformity or shorter leg length. Distance from the hinge point and the center of deformity was negatively correlated to the difference in the correction angle.

Is Severe Medial Knee Osteoarthritis a Risk Factor for Dissatisfaction Following Medial Open-Wedge High Tibial Osteotomy in Patients 55 Years of Age or Younger?

Kim MS (Catholic Univ)

Purpose: Although previous studies have shown that severe medial knee osteoarthritis (OA) (Kellgren-Lawrence grade IV) is a risk factor for patient dissatisfaction following medial open-wedge high tibial osteotomy (MOWHTO), it is uncommon to perform arthroplasty as a primary surgical option in patients 55 years of age or younger. Thus, the purpose of our study was to evaluate whether severe medial knee OA is a risk factor for dissatisfaction following MOWHTO depending on patient age based on a cutoff of 55 years.

Material and Methods: We retrospectively reviewed the data of 270 consecutive patients who underwent MOWHTO with a minimum of 2 years of follow up. Patients were divided into 2 groups based on satisfaction following surgery, a Satisfied group (new Knee Society Score satisfaction subscore > 20) and a Dissatisfied group (≤ 20). In order to assess risk factors for patient dissatisfaction depending on the age range, a subgroup analysis was conducted based on a cutoff age of 55 years. Preoperative demographics, OA grade, articular cartilage and meniscus status, severity of varus deformity, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and surgical factors were compared.

Results: At 2 years after surgery, binomial logistic regression analysis showed that severe medial knee OA was associated with patient dissatisfaction following HTO in the entire cohort (odds ratio [OR] 4.557, 95% confidence interval [CI] 2.300-9.030, $p < 0.001$). In subgroup analysis depending on age range, severe medial OA was not a risk factor for dissatisfaction in the age ≤ 55 years group. However, severe medial knee OA in the age > 55 years group was a significant risk factor for dissatisfaction after MOWHTO (OR 6.78, 95% CI 2.979-15.431, $p < 0.001$).

Conclusion: Severe medial OA was not a risk factor for dissatisfaction in patients age 55 years or younger who underwent MOWHTO. Therefore, surgeons can take this result into account when counseling younger patients considering MOWHTO.

Medial Opening Wedge Distal Tibial Tuberosity Osteotomy Is Superior to Medial Opening Wedge High Tibial Osteotomy in Patient-reported Outcome Measures after Minimum Five-year Follow-up

Ogawa H, Nakamura Y, Ichikawa K, Ota Y, Takagi K, Akiyama H (Gifu Univ)

Purpose

Medial opening-wedge high tibial osteotomy (OWHTO) induces patellofemoral joint osteoarthritis, whereas medial opening wedge distal tibial tuberosity osteotomy (OWDTO) does not produce this effect. Therefore, it is hypothesized that this disparity in the impact on the patellofemoral joint between OWHTO and OWDTO may cause OWDTO to exhibit superior mid-term clinical outcomes compared to OWHTO. This study aimed to evaluate the mid-term clinical outcomes of OWDTO and OWHTO.

Methods

This retrospective study included patients who underwent OWHTO (n = 38) and OWDTO using the thin tibial tuberosity osteotomy technique (n = 45), and the mean follow-up periods were 8.2 ± 0.6 and 5.8 ± 0.6 years, respectively. The alignment of the lower limb and the patellofemoral joint were radiographically assessed preoperatively and at the most recent follow-up visit. The Knee Society Score (KSS), the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Kujala scale were compared between the groups.

Results

One patient in the OWHTO group underwent conversion to total knee arthroplasty. The lower limb alignment parameters were not different between the groups. Regarding patellofemoral joint alignment, the postoperative Caton–Deschamps index was significantly lower in the OWHTO group than in the OWDTO group ($P < .001$). The OWDTO group was significantly superior to the OWHTO group in terms of KSS knee score ($P = .001$), and WOMAC pain ($P = .042$), function ($P = .042$), and total scores ($P = .033$).

Conclusions

OWDTO using the thin tibial tuberosity osteotomy technique is superior to OWHTO in mid-term clinical outcomes. A plausible explanation is that OWDTO did not induce patellar infera that increases contact pressure in the PF joint and the knee extensor mechanism, in contrast to OWHTO. The survival rate of patients with OWDTO may be sustained over a longer duration than that of patients with OWHTO.

Clinical outcome of joint preserving surgery for severe and end stage osteoarthritis of the knee with

Clinical outcome of joint preserving surgery for severe and end stage osteoarthritis of the knee with Tibial Condylar Valgus Osteotomy

Teramoto T, Nishii Y(Chikamori hospital)

Osteotomy, mainly HTO, is the most common joint-preserving surgery for osteoarthritis of the knee, but it is performed in cases up to the moderately stage of the disease. Tibial Condylar Valgus Osteotomy (TCVO) was first reported by Chiba in 1989 as a joint-preserving procedure for knee osteoarthritis, and it has been used in severe and end-stage osteoarthritis of the knee. In this study, we describe the results of TCVO for severe osteoarthritis of the knee. Patients were 104 knees with a %MA of 25% or less on standing full-length lower extremity radiographs, grade 3 or 4 according to the Kellgren-Laurence classification. The mean follow-up was 8 years and 5 months. Preoperative and postoperative radiographic findings, dynamic instability of the knee joint under fluoroscopic guidance, %MA and JOA scores at preoperative and final investigations were compared.

The preoperative narrowed medial joint fissure remained narrowed postoperatively, but the opened lateral joint fissure was altered, and the femoral medial condyle and tibial medial articular surface and the femoral lateral condyle and tibial lateral articular surface were adapted to be nearly homogeneous, respectively. The varus/valgus instability seen preoperatively under fluoroscopic guidance was reduced or eliminated postoperatively. The %MA improved from -6.8% to 59.2% preoperatively, and the JOA score improved from 45.3 points preoperatively to 81.1 points postoperatively. The good results were maintained even more than 10 years after surgery. TCVO may be an option for joint-preserving surgery for patients with end-stage arthrosis if they have joint instability and knee flexion is maintained at 90 degrees or more.

Session 8 Special Japan lecture 2

Is bone graft needed in Open Wedge HTO?

Takeshi Sawaguchi

Department of Traumatology, Fukushima Medical University

Trauma Reconstruction Center, Shinyurigaoka General Hospital

Medial open wedge high tibial osteotomy (MOWHTO) is a widely accepted surgical procedure for varus knees and provides good pain relief and good functional recovery. There has been controversy as to whether to fill the gap with autogenous graft, allograft, bone substitute, mixed graft or leave the gap intact. There are several randomized controlled trials and systematic reviews. Many of them conclude that there is no conclusive advantage to OWHTO with any bone void filler in terms of union rates, loss of correction and functional recovery. Opening gaps smaller than 10 mm fixed with locking plate can be managed successfully without bone grafting. According to our FEM analysis, opening gap without graft fixed with locking plate creates favorable biomechanical environment to generate gap filling with bone in MOWHTO. In addition, autogenous graft is harmful to the patient. Allograft and bone substitute need additional cost. However, in cases of obesity, lateral hinge fracture, large osteotomy gaps, or correction angles greater than 10°, bone grafting should be considered. In cases of nonunion or delayed union, the autogenous bone graft is still the gold standard.

Conclusion: Bone grafting is not required in open wedge HTO when the opening gap is small and fixed with a locking plate.

Current concepts on biotherapy & HTO for OA

Norimasa Nakamura, MD PhD

Prof. Global center for medical engineering and informatics, Osaka University

The key to joint function-preserving treatment for osteoarthritis is to control the biological environment within the joint, i.e. to maintain the balance between tissue formation and destruction, and to improve the mechanical environment. As biological approach, biotherapies have attracted attention in recent years. Typically they are using cells and/or blood-derived products including platelet-rich plasma (PRP). The cells include chondrocytes and various stem cells. Initially, the most common method of their administration was intra-articular transplantation by surgical treatment, but more recently non-surgical treatment through intra-articular injection of the cells has been widely used. On the other hand, periarticular osteotomy or joint distraction are used to restore the mechanical environment, among which several osteotomy procedures are widely used clinically. In this presentation, potential therapeutic advantages of the combination of biotherapy and osteotomy over conventional treatment will be discussed with literature review.

Session 9 Panel Discussion Yoon Jung Ro/ Seon Jong Keun

HTO complications & abnormal posterior slope(3 cases)

Presentor Lee Yong seuk

Lee Bum Sik, Han Hyuk Soo, Kim Man Soo, Matsushita T

Coffee break or HTO workshop **Sawaguchi T/Park Yong Jee**

Lee Jin Kyu, Kim Gi Beom, Park Sang Hoon, Choi Won Kee

Session 10 HTO or DFO complications Kyung Hee Soo/Kuriyama S

Can status of superficial medial collateral ligament proximal tibial attachment predict progression of OA knee?

Jung Woon Hwa, Sanchit Roy, Takeuchi R (Murup Hospital)

Abstract

Objective: This study aims to identify, whether knee OA progression is affected by the sMCL proximal tibial attachment status and probably is the first one trying to identify such association.

Methods: 90 OA knees and 80 normal knees were evaluated using radiographs and MRI for severity of OA knee (K-L grade), sMCL length (L), distance of distal tibial attachment of sMCL from tibial articular surface (I), MCL ratio (L/I) and proximal tibial attachment of sMCL, attached or detached.

Results: Mean age of the study population was 52.93±19.52 years. 106 were female knees and 59 were male. Status of sMCL proximal tibial attachment had highly statistically significant negative correlation with severity of OA knee (p-value <0.001).The status of sMCL proximal tibial attachment shows statistically significant negative correlation with sMCL distal tibial attachment and significant positive correlation MCL ratio. But there was no significant correlation with sMCL length. Knees with lower MCL ratio (L/I) have significant higher grade of OA knee as they shows statistically significant negative correlation.

Conclusion: Detached sMCL proximal tibial attachment is found to be a strong predictor of OA knee progression. Assessing the status of sMCL proximal tibial attachment will not only help the physician identifying medial stability of the knee, but also assist in planning therapy for the knee in question.

Type III lateral hinge fractures can be caused by forcible opening of insufficient posterior osteotomy during open-wedge high tibial osteotomy

Kuriyama S, Morita Y, Nakamura S, Nishitani K, Matsuda S (Kyoto Univ)

Purpose: The aim of this study was to use the finite element method (FEM) to reproduce fracture lines that reach the lateral tibial plateau during open-wedge high tibial osteotomy in knees with Type III lateral hinge fracture (LHF).

Methods: This study used the FEM to analyze the data of eight knees with Type III LHF. To predict the onset of Type III LHF, simulation models were developed in which posterior osteotomy sufficiency varied from 50% to perfect, the latter defined as osteotomy reaching the hinge point.

Results: Real-life instances of Type III LHF caused by insufficient posterior osteotomy were reproduced in all patient-specific FEM models. During opening of the osteotomy gap, the fracture line reached the lateral tibial plateau and extended vertically from the end of the insufficient posterior osteotomy, avoiding the rigid proximal tibiofibular joint. Posterior osteotomy extension ≥ 70% of the width of the osteotomy plane was the cut-off value to prevent Type III LHF.

Conclusion: Forced opening of insufficient posterior osteotomy was found to be a biomechanical cause of Type III LHF, avoiding the proximal tibiofibular joint. Sufficient posterior osteotomy, defined as at least 70% of the width of the osteotomy plane, can prevent Type III LHF.

Delayed bone union resulted in slower recovery of knee extensor muscle strength in MOWDTO

Hiramatsu K, Yamasaki N, Fukumura R, Yamada Y, Nakamura N, Mitsuoka T, Tamai N (Tamai Hospital)

【Purpose】There are some cases of delayed recovery of knee extensor strength after MOWDTO. This study examined factors associated with recovery of postoperative knee extensor strength. We hypothesized that bone union might be a factor related to delayed recovery of postoperative knee extensor strength. Therefore, we examined the relationship between postoperative knee extensor muscle strength and bony union.

【Methods】A total of 48 knees (age 60.9 ± 8.1 years, correction angle 7.6 ± 1.7°) that had undergone MOWDTO were included in this study. First, postoperative computed tomography (CT) was performed 3 months after surgery to evaluate bone union, and the patients were divided into two groups according to the presence of bone union (bone union (+): 35 knees in group U; bone union (-): 13 knees in group N). Then, knee extensor muscle strength was measured preoperatively and at 6 and 12 months postoperatively, and the ratio of postoperative knee extensor strength to preoperative strength was calculated and compared between the two groups (Mann-Whitney U test). Visual analog scale (VAS) and Knee injury and Osteoarthritis Outcome Score (KOOS) at each time period were also compared between the two groups.

【Results】The ratio of knee extensor strength to preoperative strength was 138.6%/106.6% in the U group and 164.1%/111.3% in the N group at 6 months and 12 months postoperatively, respectively, showing a significant difference ($p<0.05$) between the two groups at both 6 and 12 months after surgery. The VAS ranged from 46.3/45.2 in the U and N groups preoperatively to 9.1/14.4 at 6 months and 9.3/8.7 at 12 months postoperatively, respectively, with a significant difference ($p<0.05$) between the two groups at 6 months postoperatively. KOOS ranged from 47.5/49.5 in the U and N groups preoperatively to 72.9/70.7 at 6 months and 77.9/80.2 at 12 months postoperatively, respectively, with no significant difference between the two groups.

【Conclusion】Knee extensor strength at 6 and 12 months after MOWDTO surgery was significantly lower in patients with delayed bone union at 3 months postoperatively. Delayed bone union may have resulted in prolonged pain, which may have delayed recovery of muscle strength.

Incidence and Risk Factors for Lateral Hinge Fractures in Medial Opening Wedge High Tibial Osteotomy and Medial Opening Wedge Distal Tibial Tuberosity Osteotomy

Hori S, Ogawa H, Nakamura Y, Ichikawa K, Ota, Y, Akiyama H (Gifu Univ)

Abstract

Purpose: The aims of this study were (1) to compare the incidence of lateral hinge fractures (LHFs) in medial opening-wedge high tibial osteotomy (OWHTO) and medial opening-wedge distal tibial tuberosity osteotomy (DTO), and (2) to investigate the risk factors for LHFs. The incidence of LHFs was hypothesized to be higher in the DTO group than the OWHTO group. The DTO procedure is also a risk factor for LHFs.

Methods: A total of 167 knees that underwent OWHTO (n = 65) and DTO (n = 102) were subjected to propensity score matching for the comparison of the groups. The matched variables were sex, preoperative hip-knee-ankle (HKA) angle, and preoperative medial proximal tibial angle. Forty-one matched pairs were enrolled for comparative analysis. Logistic regression analysis was performed to investigate risk factors for LHFs.

Results: The incidence of LHFs was not significantly different between the groups (34.1% vs. 26.8%, respectively; p = 0.631). Logistic regression analysis showed that age (odds ratio: 1.074, 95% confidence interval (CI): 1.020–1.131, p = 0.007), BMI (odds ratio: 1.150, 95% CI: 1.049–1.260, p = 0.003), and preoperative HKA angle (odds ratio: 1.150, 95% CI: 1.049–1.260, p = 0.035) were significant risk factors for LHFs. The difference in surgical technique between OWHTO and DTO was not a risk factor for LHFs (p = 0.204).

Conclusions: The incidence of LHFs is similar in DTOs and OWHTOs, and the DTO procedure is not a risk factor for LHFs

Session 11 HTO & DFO Biomechanics Choi Chong Hyuk/ Lee Yong Seuk

Implant Removal After Medial Opening Wedge High Tibial Osteotomy Provides Implant-Related Pain Relief and Functional Improvement

Song Si Young (Hallym Univ)

Purpose: To investigate the incidence of implant-related pain after medial opening wedge high tibial osteotomy(MOWHTO) using a locking plate, to determine whether implant removal provides pain relief and functional improvement, and to evaluate bone healing and loss of correction after implant removal.

Methods: Between March 2014 and September 2017, MOWHTO was performed without bone graft. The inclusion criteria were patients who underwent implant removal after MOWHTO and were followed up for a minimum of 2 years. Patients were evaluated for implant removal 1 and 2 years after surgery. Clinical and functional evaluations were conducted to investigate implant-related

pain using the visual analog scale, Lysholm score, and Tegner score. The radiographic indices measured were the gap filling rate, weightbearing line (WBL) ratio, hip-knee-ankle angle (HKAA), medial proximal tibial angle (MPTA), and posterior tibial slope angle (PTSA).

Results: A total of 55 patients were enrolled. Fifty-one (92.7%) patients experienced

implant-related pain prior to implant removal, with 43 and 8 patients reporting mild pain and moderate pain, respectively. At 1 and 2 years after implant removal, mild pain occurred in 6 (10.9%) and 5 (9.1%) patients, respectively. The remaining patients reported no implant-related pain. Prior to implant removal and 1 year after implant removal, the Lysholm score improved from 77.0 ± 5.6 to 86.8 ± 5.7 ($P < .001$), and the Tegner score improved from 3.3 ± 1.2 to 3.9 ±1.3 ($P < .001$). The mean gap-filling rate was 84.4% ± 9.6% at implant removal, and it significantly increased to 93.7% ± 5.4% and 97.4% ± 2.6% at 1 and 2 years after implant removal, respectively ($P < .001$). For the WBL ratio, HKAA, MPTA, and PTSA, no statistically significant differences were found after implant removal.

Conclusions: The incidence of implant-related pain after MOWHTO using the medial proximal tibial locking plate was high. Implant removal provides pain relief and functional improvement (met minimal clinically important differences). Even after implant removal, bone healing progressed gradually without a loss of correction in all patients.

A case of unintended valgus malalignment after distal femoral derotational osteotomy in a patient with recurrent patella dislocation : How to prevent it?

Kim Hun Kwon, Cho Min Soo, Jang Sung Jun, Lee Hyung Min, Park Ji Su, Kim Tae Woo,

Chang Moon Jong, Kang Seung Baik (Seoul National Univ)

Introduction

Femoral derotational osteotomy is usually recommended for patients who have symptomatic excessive anteversion of the femur.
However, recent studies have indicated that changes in frontal plane alignment can occur after femoral derotational osteotomy.
In cases of patellofemoral instability, performing a derotational osteotomy can lead to unintended valgus malalignment, which contradicts the original goal of addressing patellofemoral malalignment, since valgus malalignment is recognized as an independent risk factor for patellofemoral instability, separated from maltorsion.
In this study, we will introduce a case from out clinic of unintended valgization that occurred after performing distal femoral derotational osteotomy in a patient with recurrent patellar dislocation, and aim to discuss methods to prevent it with reviewing previous published researches.

Case

Female / 23 ; out-patient visit ; August, 2023
Initial patellar dislocation : January, 2023 after slip down : long leg cast for 6 weeks
Recurrent patellar dislocation : July, 2023 after pivoting ; 5-6 times of dislocation for 3 days
Physical examination : Effusion (+) / Apprehension test (+) / J sign (+) / Generalized laxity (+)
Merchant view : patellar subluxation can be observed starting from mid-flexion (30°).
Lateral radiograph : Insall-Salvati ratio 1.28 (Patella alta)
MRI : MPFL rupture (+) / Loose body (-)
CT : TT-TG 17mm / femoral anteversion 30.3°
<Surgical plan>
- MPFL rupture → MPFL reconstruction with tibialis anterior allograft
- Excessive femoral anteversion → distal femoral derotational ostetomy
Pre-/Post-operative Teleradiograph

Frontal alignment : Varus 0.4° → valgus 3° : unintended valgization

Discussion

Many studies have shown that distal femur derotational osteotomy primarily promotes valgus alignment.
However, Imhoff et al. stated in their conceptual study using a trigonometrical model that even when performing distal femur derotational osteotomy, if the cutting plane is perpendicular to the frontal and lateral virtual anatomical shaft axis, the medial lateral distal femoral angle (mLDFA) will

slightly increase, helping to avoid unintended valgus malalignment.
Subsequently, a cadaveric study using the same mathematical model indicated that depending on the angle of the cutting plane relative to the lateral virtual anatomical shaft, it is possible to perform neutral, valgus-producing, or varus-producing osteotomies. (figure 1)

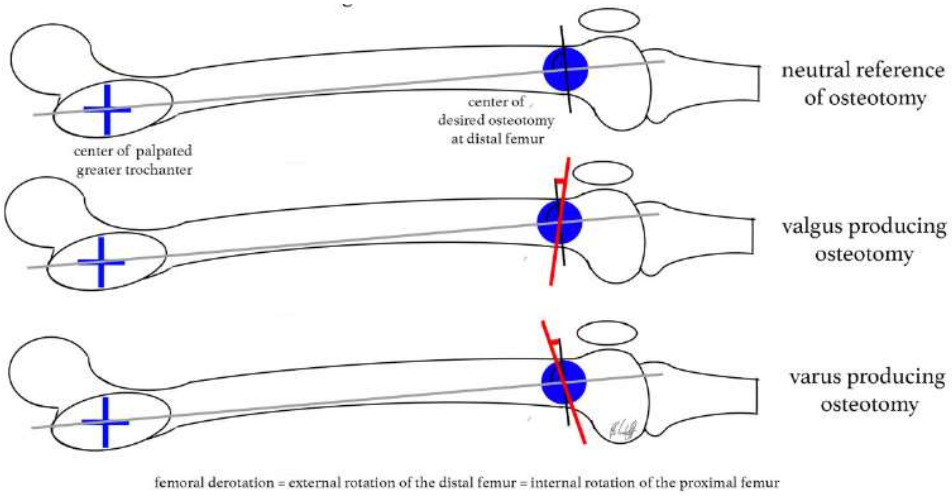
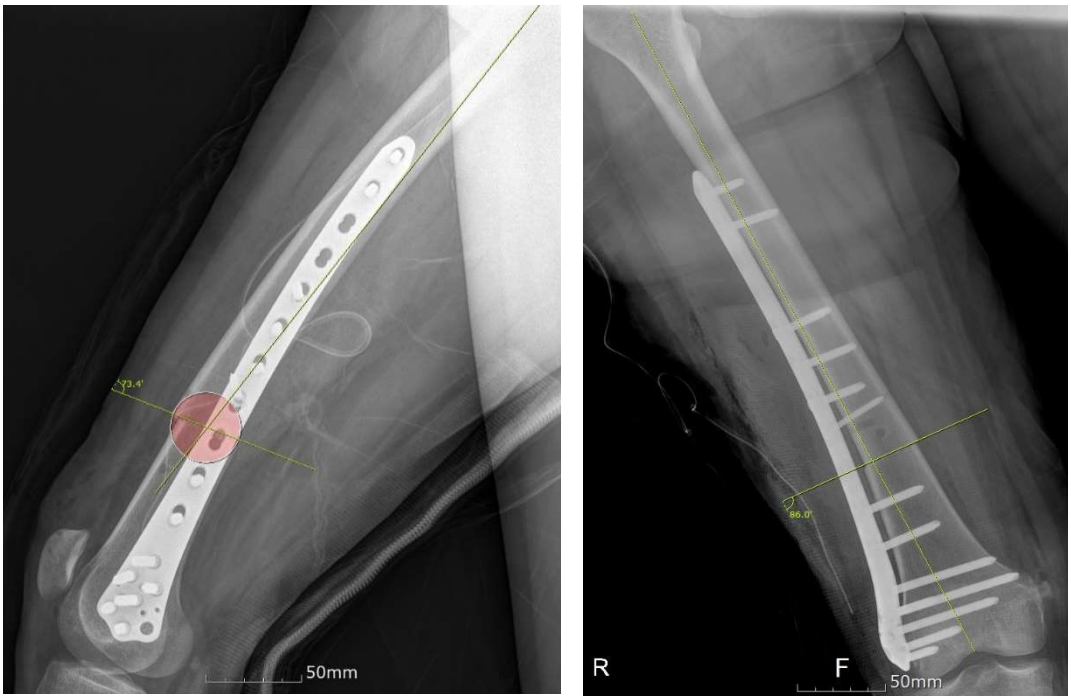


figure 1 Cutting plane angle and frontal alignment

(Imhoff, et al. Orthopaedic Journal of Sports Medicine, 2018.)

Conclusion

At the osteotomy site, the cutting plane formed an angle of **73.4 degrees** with the lateral virtual anatomical shaft, resulting in a **valgus-producing osteotomy**. It is believed that if the cutting plane had been **more perpendicular or at an obtuse angle**, a **neutral- or varus-producing osteotomy** could have been achieved.



Mono-plane medial closing wedge distal femoral osteotomy with condylar hinge is a feasible surgical method to reduce hinge fractures

Matsushita T, Nishida K, Tanaka A, Sano S, Nakanishi Y, Nagai K, Hoshino Y, Kuroda R (Kobe Univ)

Introduction Although good clinical outcomes after MCWDFO have been reported, hinge fracture has been reported as one of the most common complications in MCWDFO. Previous studies suggested that the supra-condylar hinge position was associated with hinge fractures. Meanwhile, creating the anterior flange appropriately in biplanar technique appears to be technically demanding. Therefore, we have modified our surgical technique as mono-planar MCWDFO (MP-MCWDFO) with a condylar hinge (CH). The purpose of this study was to examine hinge fractures and bone union after MP-MCWDFO-CH.

Methods Twenty-three knees of 28 patients who received MP-MCWDFO-CH for the treatment of lateral compartmental osteoarthritis or cartilage injuries combined with valgus knee alignment were prospectively followed from Jan. 2020 (mean age 46.4 ±13.7 y.o., 12 males, 15 females). During the surgery, the target hinge position was carefully set to be in the condylar region defined as the area distal to the proximal margin of the lateral distal femur. A locking plate was used to fix the osteotomy site. Partial weight bearing of one-third of the body weight was permitted at two weeks postoperatively, and full weight bearing was permitted five to six weeks after surgery. The incidence of displaced hinge fracture during surgery was recorded and the presence of hinge fracture was assessed using CT images taken 2 weeks after surgery. The progression of bone union three and six months after surgery was assessed using a bone union scoring system (0-6 points, higher score indicates better union). Bone union score of more than 5 was defined as almost complete bone union.

Results The mean resected wedge width was 5.8±2.0 mm. No displaced hinge fracture occurred during surgery. The incidence ratio of hinge fracture detected in the CT images at 2 weeks was 2/29 (8.7 %) patients. In one patient, late hinge fracture was found 8 weeks after surgery. Almost complete bone union was obtained in 21/28 (75%) patients at 3 months postoperatively and 21/23 (89.3%) patients at 6 months postoperatively.

Conclusions The incidence ratio of hinge fracture was low compared with previous reports and a good bone union was achieved within 6 months after surgery. MP-MCWDFO~CH is a feasible surgical technique for MCWDFO to reduce hinge fractures.

The Biomechanical Comparison of Hinge Fracture between Single-plane and Bi-plane Medial Closing Wedge Distal Femoral Osteotomies Using Finite Element Analysis

Matsushita T, Nishida K, Nakanishi Y, Nagai K, Hoshino Y, Nakatsuji T, Katsui Y, Mukai T, Kuroda R,Tanaka A(Kobe Univ)

Introduction Hinge fracture is a frequent complication of medial closing wedge distal femoral osteotomy (MCWDFO). We have previously reported that the condylar hinge position would reduce the risk of hinge fracture in single-plane (SP) MCWDFO. Meanwhile, bi-plane (BP) technique is widely used as a surgical technique for MCWDFO. However, there is a difference in risk of hinge fracture between the single- and bi-plane techniques has not yet been examined. This study aims to investigate the risk of hinge fracture between single-plane and biplane MCWDFO with different hinge positions using finite element analysis (FEA). The hypothesis was that the risk of hinge fracture would be reduced by setting the appropriate hinge position regardless of osteotomy techniques.

Methods Three-dimensional knee models were created from preoperative computed-tomography (CT) images of 11 knees of 10 patients who underwent MCWDFO for the valgus knee: Virtual MCWDFO was performed in each knee with four difference conditions: SP osteotomy with condylar hinge (SP-C) and supra-condylar hinge (BP-S), BP osteotomy with condylar hinge (BP-C) and supra-condylar hinge (BP-S). The condylar and supra-condylar hinge positions were set to be 5 mm distal and proximal to the proximal margin of the lateral distal femur, respectively. The correction angle was set at 5 degrees. The anterior flange thickness of the bi-plane osteotomy was 25% of the overall hinge thickness. As the boundary condition, the most proximal parts of the models were fixed. The appropriate displacements at the femoral medial condyle were set to close the wedge completely. Young's modules were calculated using their CT values based on the data proposed by Keyak et al. Poisson's ratio was set at 0.40. The convergence test was conducted by applying 1.5 mm tetrahedral mesh for the cancellous and inner cortical bone, and 0.4 mm shell for the outer surface of the cortical bone. The number and distribution of failure shell elements in the hinge area were compared after closing the gap.

Results The number of failure shell elements in SP-C, SP-S, BP-C, and BP-S were 67.7 ± 45.9, 206.3 ± 86.0, 70.6 ± 59.6, and 177.9 ± 59.3, respectively. The number of failure shell elements in the models with supra-condylar hinge (SP-S and BP-S) was significantly larger than those in the models with condylar hinge (SP-C and BP-C) (SP-S or BP-S vs SP-C and vs BP- C, all $P < 0.05$). There was no difference in the number of failure shell elements between SP-C and BP-C and between SP-S and BP-S.

Conclusion In MCWDFO, the risk of hinge fracture can be reduced by setting the hinge position within the lateral condylar area regardless of single-plane or bi-plane techniques.

Session 12 Miscellaneous **Lim Hong Chul/Kang Seung Baik**

Particulated Costal Hyaline Cartilage Allograft With Subchondral Drilling Improves Joint Space Width and Second-Look Macroscopic Articular Cartilage Scores Compared With Subchondral Drilling Alone in Medial Open-Wedge High Tibial Osteotomy

Shon Oog Jin, Kim Gi Beom (Yeungnam Univ)

Purpose: To compare the articular cartilage regeneration based on second-look arthroscopy in patients who underwent medial open-wedge high tibial osteotomy (MOWHTO) combined with particulated costal hyaline cartilage allograft (PCHCA) implantation with those who underwent MOWHTO and subchondral drilling (SD). Moreover, we compared the clinical and radiographic outcomes between the groups.

Methods: From January 2014 to November 2020, patients with full-thickness cartilage defect on the medial femoral condyle who underwent MOWHTO combined with PCHCA (group A) or SD (group B) were reviewed. Fifty-one knees were matched after propensity score matching. The status of regenerated cartilage was classified according to the International Cartilage Repair Society-Cartilage Repair Assessment (ICRS-CRA) grading system and Koshino staging system, based on second-look arthroscopic findings. Clinically, the Knee Injury and Osteoarthritis Outcome Score, the Western Ontario and McMaster Universities Osteoarthritis Index, and range of motion were compared. Radiographically, we compared the differences in the minimum joint space width (JSW) and change in JSW.

Results: The average age was 55.5 years (range, 42-64 years), and the average follow-up period was 27.1 months (range, 24-48 months). Group A showed a significantly better cartilage status than group B based on the ICRS- CRA grading system and Koshino staging system (P < .001 and <.001, respectively). There were no significant differences in clinical and radiographic outcomes between groups. In group A, the minimum JSW at the last follow-up was significantly increased than that before surgery (P ¼ .013), and a significantly greater increase in JSW was observed in group A (P ¼ .025).

Conclusions: When performed with MOWHTO, the combination of SD and PCHCA was associated with superior articular cartilage regeneration on the ICRS-CRA grading and Koshino staging on second-look arthroscopy performed at a minimum of 2 years follow-up than SD alone. However, there was no difference in clinical outcomes.

Level of Evidence: Level III, retrospective comparative study.

The clinical effect of medial meniscus root tear with repair using all-inside meniscal repair device after open wedge HTO

Kim Hee June, Kyung Hee Soo (Kyungpook National Univ)

This study evaluated the clinical and radiological results of medial meniscus posterior tear (MMPRT) repair using an all-inside meniscal repair device combined with a high tibial osteotomy (HTO) compared to cases without MMPRT and MMPRT repair during the HTO.

A total of 233 patients (202 knees) who underwent open-wedge HTO using a locking plate were evaluated. The mean age was 57.5 (range, 39–67) years. Eighty-seven patients had MMPRT on preoperative magnetic resonance imaging (MRI) and intraoperative arthroscopic evaluation. During HTO, the all-inside meniscal repair was performed in 29 cases. In 58 cases with MMPRT, only partial meniscectomy of the movable torn meniscus was conducted. The preoperative and 12-month postoperative clinical and radiologic results were compared. The factors influencing the results, including age, preoperative osteoarthritis, and postoperative alignment between clinical results, were analyzed.

The three groups showed no differences in demographics, preoperative Kellgren-Lawrence (K-L) grade, and clinical scores. In all groups, clinical scores significantly improved at 1-year follow-up after surgery. The degree of arthritis significantly increased in all three groups. The groups did not differ in the postsurgical progression of arthritis, clinical scores, and degree of change. Compared to preoperative evaluation, the degree of improvement in clinical scores among the three groups according to age, K-L grade, and postoperative alignment did not differ.

There was no difference in clinical and radiographic results after HTO regardless of MMPRT repair using the all-inside meniscal suture device, including osteoarthritis progression. In patients with MMPRT, HTO without MMPRT repair could be a good treatment method.

Preoperative Hindfoot Alignment and Outcomes After High Tibial Osteotomy for Varus Knee Osteoarthritis: We Walk on Our Heel, Not Our Ankle

Yang Hong Yeol, Seon Jong Keun, Park Chan Jin, Cheon Jae Hyeok, Jeong Woo Jin

(Chonnam National Univ)

Purpose: The hip-to-calcaneus axis, previously known as the ground mechanical axis (GA), ideally passes through the center of the knee joint in the native knee. The aim of this study was to elucidate, with use of hip-to-calcaneus radiographs, changes in knee and hindfoot alignment and changes in outcomes following high tibial osteotomy (HTO).

Methods: We reviewed the records for 128 patients who underwent HTO between 2018 and 2020. Patients were stratified into 2 groups, a hindfoot valgus group (n = 94) and a hindfoot varus group (n = 34), on the basis of their preoperative hindfoot alignment. The hindfoot alignment was evaluated with use of the hindfoot alignment angle (HAA). To evaluate lower-limb alignment, full-length standing posteroanterior hip-to-calcaneus radiographs were utilized to measure 4 radiographic parameters preoperatively and 2 years postoperatively: the hip-knee-ankle (HKA) angle, hip-knee-calcaneus (HKC) angle, and the weight-bearing line (WBL) ratios of the mechanical axis (MA) and GA.

Results: The mean HAA improved significantly from 5.1° valgus preoperatively to 1.9° valgus postoperatively in the hindfoot valgus group ($p < 0.001$). In contrast, in the hindfoot varus group, the HAA showed no meaningful improvement in the coronal alignment of the hindfoot following HTO ($p = 0.236$). The postoperative mean HKC angle in the hindfoot varus group was 2° more varus than that in the hindfoot valgus group (1.0° versus 3.0°; $p = 0.001$), and the GA in the hindfoot varus group passed across the knee 8.0% more medially than that in the hindfoot valgus group (55% versus 63% from the most medial to the most lateral part of the tibial plateau). The hindfoot varus group had worse postoperative clinical outcomes than the hindfoot valgus group in terms of the mean Knee injury and Osteoarthritis Outcome Score for pain and American Orthopaedic Foot & Ankle Society Ankle-Hindfoot Score.

Conclusions: Although our findings did not provide sufficient evidence to establish clinically relevant differences between the groups, they indicated that the group with a preoperative fixed hindfoot varus deformity had a higher rate of undercorrection and worse clinical outcomes, especially pain, following HTO. Therefore, modification of the procedure to shift the GA more laterally may be required for these patients.

Abnormal Branching of the Anterior Tibial Artery

Harada T (Yokohama Sekishinkai Hospital)

[Purpose]

A critical complication of knee surgery is popliteal artery injury. Normally, the popliteal artery branches into the anterior tibial artery near the inferior border of the popliteus muscle, followed by the branching of the posterior tibial and fibular arteries. However, in some cases, the anterior tibial artery branches proximally, warranting caution. This study aimed to investigate the frequency of proximal branching anomalies of the anterior tibial artery.

[Methods]

This study included 309 knees from 215 patients (82 males and 133 females; 70 right knees, 51 left knees, and 94 bilateral knees) who underwent knee MRI at our institution. Using knee MRI, we examined the branching position of the anterior tibial artery from the popliteal artery and its relationship with the popliteus muscle.

[Results]

Proximal branching of the anterior tibial artery was observed in 6 of 309 cases (1.94%). Among these, 3 cases (0.97%) involved branching anterior to the popliteus muscle.

[Conclusion]

This study identified cases where the anterior tibial artery branched proximally and ran anterior to the popliteus muscle. In such cases, the anterior tibial artery passes immediately behind the tibial cortical bone, significantly increasing the risk of arterial injury during surgeries such as total knee arthroplasty or high tibial osteotomy. Preoperative confirmation of the popliteal artery's course using MRI or other imaging modalities is considered crucial for ensuring surgical safety.

Session Final **Panel Discussion 2**

HTO lateral hinge Fx & TKA revision after HTO (2 cases) Kim Kang Il/ Sohn Oog Jin

Presentor Bae Ji Hoon

Jang Ki Mo, Chang Moon Jong, Kim Hee June, Ogawa H

HTO infection & HTO Cx **(2 cases)** Kim Sung Jung/Jung Woon hwa

Presentor Bae Ki Cheor

Kim Young Mo, Kim Jae Gyoon, Lee Sang Hak, Japan?

DFO complication & patella intablity (G valgum) (2 cases) Ha Chul Won/Lee Han Jun

Presentor Han Jae Hwi

Lee Dae Hee, Kim Sung Hwan, Kim Dong Hwi, Tensho K

Japan e Poster

Short-Term Outcome and Clinical Improvement in Medial Open-Wedge Distal Tuberosity Tibial Osteotomy for Early Osteoarthritis of The Knee

Yoshitaka Nakao (Hyogo Univ)

INTRODUCTION: Osteotomy around the knee is a commonly employed treatment for active patients with knee osteoarthritis (OA), and favorable outcomes have been reported. Several studies have examined the factors that influence the clinical outcomes of osteotomies. Among them, the severity of preoperative osteoarthritis is a factor that may affect postoperative clinical outcomes. However, the effect of preoperative osteoarthritic severity on the surgical outcomes has not been clarified. Although some studies have reported clinical results after Medial Open-Wedge Distal Tuberosity Tibial Osteotomy (DTO), clinical outcomes of DTO for mild osteoarthritis of the knee has yet to be investigated. The purpose of this study was to investigate the short-term clinical outcome of DTO for early knee OA.

METHODS: Patients with early knee OA (Kellgren-Lawrence [K-L] grade 0 or 1) who underwent DTO at our hospital during the study period of August 2018 to April 2022 were included in the study. Subjects were periodically followed up after surgery, and pre- and postoperative radiological and clinical data at 2 years after surgery were retrospectively reviewed for each of the knees. Those without a minimum of 2 years of complete follow-up data were excluded. Clinical results were assessed using the Knee Injury and Osteoarthritis Outcome Score (KOOS) and the International Knee Documentation Committee (IKDC) subjective score preoperatively and at 2 years after surgery. As for the radiological parameters for alignment and bone/joint geometry, the following angles were measured on a long-leg weight-bearing radiograph using dedicated software (mediCAD): hip knee ankle angle(HKAA),mechanical medial proximal tibial angle (mMPTA), % mechanical axis(%MA).

RESULTS: The study population consisted of 26 patients (20 males and 6 females) who underwent DTO during the study period, for a total of 30 knees. The average patient age was 53.7±4.8 years (range: 44 years to 63 years). Preoperatively, the mean KOOS-5 and IKDC subjective scores were 64.4±18.5 and 57.4±20.7, respectively. Two-years post-surgery, these scores increased to 91.1±9.0 for the KOOS and 84.9±10.8 for the IKDC subjective scores, showing significant postoperative improvement in both PROMs. Preoperatively, the mean HKAA was 4.1±2.8° (varus), the mean mMPTA was 84.2±1.8°, and the mean %MA was 30.2±10.9°. At 2 years after surgery, the mean HKAA was 2.0±1.0° (valgus), the mean mMPTA was 90.2±1.9°, and the mean %MA was 58.4±4.6°

Conclusion: Although observed over a short period, DTO showed good clinical results for early-stage knee OA. It was suggested that performing osteotomy at an early stage may result in a better clinical score with a relatively small amount of correction.

Long term clinical outcomes after medial open-wedge high tibial osteotomy.

Kaneko M, Takahara Y (Nippon Kokan Fukuyama Hospital.)

【Purpose】

To evaluate long term clinical outcomes of medial open-wedge high tibial osteotomy (OWHTO).

【Methods】

We retrospectively evaluates clinical and radiographic outcomes of 69 patients (mean age 61.3 years, mean follow- up 114.3 months, 75 consecutive knees.) who underwent OWHTO for medial compartment osteoarthritis (OA). KL grade was used to evaluate knee OA(KL-1 18 cases ; KL-2 37 cases ; KL-3 20 cases). Our target of weight-gearing correction is between 55 and 60%. The clinical outcomes were assessed using Japanese Orthopaedic Association (JOA) scores. Radiographic outcomes were assessed using pre- and post-operative mechanical axis percentage, medial proximal tibial angle, and joint line convergence angle.

【Results】

The JOA score improved significantly from 71.5 to 92.1(pre-operative to final evaluation) in the KL-1 group, 63.9 to 89.5 in the KL-2, 71.0 to 88.7 in the KL-3. Mechanical axis percentage significantly increased from 30.2 to 57.1 and 58.0(pre-operation to 1year postoperative and final evaluation) in the KL-1 group, 23.9 to 60.1 and 56.5 in KL-2, 20.9 to 62.2 and 57.8 in KL-3.

【Conclusion】

Fujisawa recommended to align the weight-bearing line to the 62.5%, and most surgeons follow this recommendation. Our long term clinical results of OWHTO indicated excellent improvement in the JOA scores although our correction angle was mild.

The effect of Preoperative Pain Catastrophizing on Postoperative Clinical Outcomes Over Time in Around Knee Osteotomy

Hasama R Ueda S, Matsumiya K, Goshima K, Teppei M (Kanazawa Munehiro hospital)

【Purpose】Preoperative pain catastrophizing has been reported to be associated with postoperative clinical outcomes in open wedge high tibial osteotomy (OWHTO). However, its effect on postoperative clinical outcomes over time is unclear. The purpose of this study is to investigate the effect of preoperative pain catastrophizing on postoperative clinical outcomes over time in around knee osteotomy (AKO).

【Methods】We included 81 patients with 82 knees (20 males, 61 females, mean age 64.8±8.6 years, OWHTO: 67 knees, MCWDFO: 5 knees, DLO: 7 knees, OWDTO: 2 knees, iVHTO: 1 knee). Preoperative pain catastrophizing was evaluated by pain catastrophizing scales (PCS), and clinical outcomes were evaluated over time at 3 months, 6 months, and 1 year after surgery using VAS, JOA score, OKS, and KOOS. Clinical outcomes were compared between the groups (high PCS group ≧30 vs low PCS group ＜30)

【Results】The high PCS group had 19 knees (mean 38.8 points) and the low PCS group had 63 knees (mean 19.6 points). OKS and KOOS pain, ADL, Total were significantly lower in the high PCS group before surgery. KOOS symptom, pain at 3 months postoperatively, JOA score and OKS and KOOS pain at 6 months postoperatively, and KOOS pain at 1 year postoperatively were also significantly lower in the high PCS group.

【Conclusions】In AKO, preoperative pain catastrophizing affected PROMS over time before and after surgery. It has been reported that preoperative patient education is useful in reducing pain catastrophic thinking, and we provide preoperative small group guidance, explanations using videos, and more recently, patient education using apps. Patient education is important especially for high PCS patients.

Effect of β-Tricalcium Phosphate on Bone Formation in Smokers Following Open-Wedge High Tibial Osteotomy

Yamada Y(Yao Municipal Hospital)

Objective: It is well known that bone formation is delayed in smokers after open-wedge high tibial osteotomy (OWHTO). The object of this study was to investigate whether the use of β-tricalcium phosphate (βTCP) promotes bone formation in smokers after OWHTO.

Methods: The study included 10 smokers who underwent OWHTO. Six patients had artificial bone applied only to the medial side (medial group), while four patients had it applied throughout the entire area (whole area group). Bone formation was evaluated at 3 and 6 months postoperatively using plain X-rays. The osteotomy gap was divided into five zones (Zone 1-5, from lateral to medial), and bone formation in Zones 1 and 2 was compared between the two groups. Bone formation was scored (0-5) according to the modified Van Hemert Scoring System, and the scores were compared at 3 and 6 months postoperatively. The proportion of patients with a score of 4 or higher (indicating bone union) at 6 months was also compared.

Results: The whole area group had significantly higher bone formation scores than the medial group in Zone 1 at both 3 and 6 months, with a similar trend observed in Zone 2. At 6 months, 100% of the whole area group achieved a score of 4 or higher, whereas only 50% in Zone 1 and 33% in Zone 2 achieved this in the medial group.

Conclusion: The use of βTCP in the lateral region of the osteotomy site led to early bone formation in smokers.

Biomechanical Effect of the Lateral Mini-plate Fixation on Mechanical Stability in Medial Opening Wedge High Tibial Osteotomy

Yamashita S, Ohori T, Yamakawa S, Tsujii A, Akimori T, Tanaka A, Tsunematsu T, Lee C, Sata S, Ishibashi T, Tamaki M, Nakata K(Osaka Univ), Otani S(Tokyo Women's Univ)

Purpose

Medial Opening Wedge High Tibial Osteotomy (MOWHTO) is generally fixed with only a medial locking plate. However, there is insufficient lateral support despite being a procedure that shifts the load laterally, which is thought to lead to postoperative pain and lateral hinge fractures. Therefore, we added lateral mini-plate fixation to MOWHTO and compared its effect on mechanical stability with the conventional method of using only a medial locking plate.

Methods

Imitation bones (SAWBONES Tibia Scan of 4th Generation #3401, Sawbones Europe AB) were used for biomechanical testing, replicating the osteotomy of a typical MOWHTO (with a hinge point located 15 mm distal to the lateral joint surface and 5 mm medial to the lateral cortex, and the osteotomy 35 mm distal from the medial edge of the tibial joint surface, opening 12 mm from the osteotomy site). The medial fixation was performed using the TriS Medial HTO Plate System (Olympus Terumo Biomaterials), and the lateral fixation was performed using a 2-holes mini-plate from the TriS Small Plate Type I (4-holes) halved. Axial compressive tests were performed by using a precision universal testing machine (AUTOGRAPH, SHIMADZU). In the tests, the joint surface was parallel to the ground, a spherical indenter was placed at 62.5% of the distance from the medial edge of the tibial joint surface, and compressive loads of 1000 N, 2000 N, 3000 N, and 4000 N were applied sequentially. The tests were recorded from behind of the tibia using a video camera (HDR-CX370V, SONY), and the reduction distance of the opening site (mm, medial and lateral) at each load was calculated using a Motion Analyzer VW-9000 (KEYENCE). The load to failure (N) and the reduction distance of the opening site (mm) at each load were compared between two groups: group Ⅰ (only a medial locking plate) and group Ⅱ (medial locking plate with an additional lateral mini-plate), each groups are six specimen.

Results

In group Ⅰ, all specimens broke at below 3000 N, whereas in group Ⅱ, none of the specimens broke at 3000 N, and two of them did not break even at 4000 N. The average load to failure was 2398 N in group Ⅰ, while it was 3828 N in group Ⅱ assuming the failure load of the two unbroken cases to be 4000 N. The average reduction distance on the medial side of the opening site was 0.40 mm (2000 N) in group Ⅰ, and 0.0.27 mm (2000 N) in group Ⅱ, showing no significant difference.

However, the average reduction distance on the lateral side of the opening site was 0.65 mm (2000 N) in group Ⅰ, while it was 0.30 mm (2000 N) in group Ⅱ, indicating a lower reduction distance with the additional lateral mini-plate.

Conclusion

In MOWHTO, the addition of a lateral mini-plate improved mechanical stability compared to fixation with only a conventional medial locking plate. Clinically, adding mini-plate fixation at the lateral hinge can be expected to allow for earlier postoperative weight-bearing and prevention of hinge fractures.

Favorable Mid-term Clinical Results of Medial Opening Wedge Distal Tibial Tuberosity Osteotomy Using the Thin Tibial Tuberosity Osteotomy Technique: A Retrospective Study with a Minimum Four-year Follow-up

Ogawa H, Nakamura Y, Ichikawa K, Ota Y, Akiyama H (Gifu Univ)

Purpose: Data on mid-term clinical results in medial opening wedge distal tibial tuberosity osteotomy (OWDTO) is limited. This study aimed to investigate the mid-term clinical results and complications in OWDTO using the thin tibial tuberosity descending osteotomy technique.

Methods: This retrospective study included 94 knees that underwent OWDTO using the thin tibial tuberosity descending osteotomy technique. The distribution of Kellgren–Lawrence grades I/II/III/IV was 2/30/55/7 and the mean follow-up period was 5.2 ± 1.7 years with a minimum of four years. The association between the Western Ontario and McMaster Universities Arthritis Index (WOMAC) at the latest follow-up and lower-limb alignment radiographic parameters were analyzed.

Results: The WOMAC was 6.6 ± 14.2 points at the latest follow-up. Complications included late-onset infection (2.1%), lateral hinge fractures (4.2%), and intraoperative tibial tuberosity fractures (4.2%). The hip–knee–ankle angle (HKA) (positive value indicates varus) significantly decreased by approximately 1° (varus recurrence) after the first postoperative year (P = .002). The risk factors of varus recurrence were body mass index (β = .172, 95% confidence interval [CI] = .035–.039, P = .015) and valgus joint line convergence angle (β = -.266, 95% CI = -.531–-.001, P = .049). The WOMAC total score was better at -4° ≤ HKA < -3°. The risk factor of the WOMAC total score was the postoperative HKA (β = 1.425, 95% CI = .722–2.127, P < .001).

Conclusions: The mid-term clinical result of OWDTO using the thin distal tibial tuberosity descending osteotomy technique was favorable without severe complications. Surgeons who perform OWDTO should consider the risk factors of postoperative varus recurrence and mid-term clinical outcomes.

The Relationship Between HKA Angle with Tibial and Femoral Standards and Soft Tissue Correction

Ota Y, Ogawa H, Nakamura Y, Ichikawa K, Akiyama H (Gifu Univ)

Purpose: The hip-knee-ankle angle (HKA) is the angle between the center of the hip, knee, and ankle joints which indicates the lower limb alignment, but in an osteoarthritis (OA) knee, it is often difficult to identify the knee joint center due to malalignment of the knee joint surface. The purpose of this study is to identify the difference that occurs between tibial and femoral standard HKA angle before and after medial opening wedge high tibial osteotomy (MOWHTO)/ medial opening wedge distal tibial tuberosity osteotomy (MOWDTO)

Methods Sixty-one knees from 41 patients who underwent either OWHTO or OWDTO in our institution were involved. We defined femur HKA (fHKA) as the HKA with the knee joint center at femoral intercondylar fossa, and tibia HKA (tHKA) as the HKA with the knee joint center at the center of the tibial intercondylar ridge. The preoperative and postoperative tHKA, fHKA were measured (a positive value indicates valgus), and the correlation with soft tissue correction (the change in the difference between tHKA and fHKA before and after the surgery) was analyzed. Correlation between the soft tissue correction with preoperative joint line convergency angle (JLCA) and coronal tibiofemoral subluxation ratio (%CTFS) were also evaluated.

Results The average preoperative tHKA, fHKA, postoperative tHKA, fHKA were -8.6 ± 3.6°、-7.3 ±3.7°、1.9 ± 2.2°、2.8 ± 2.3°, respectively. There was a significant difference between tHKA and fHKA before and after the operation ($p<0.01$, for each comparison). The difference between tHKA and fHKA significantly changed from 1.3±0.9°preoperatively to 0.8±0.6°postoperatively. The preoperative difference in tHKA and fHKA had a significant correlation with soft tissue correction ($R=0.73$). Correlation between soft tissue correction and preoperative %CTFS and JLCA were 0.06, 0.21, respectively.

Conclusion The difference in the preoperative tHKA and fHKA could be a new parameter to predict the soft tissue correction that would occur after OWHTO/OWDTO.

The Influence in Clinical Results of Lower Limb Length Discrepancy Following Distal Femoral Osteotomy

Kim YJ, Onishi S, Kubota M, Ishijima M, Ahmed Mabrouk, Christophe Jacquet, Matthieu Ollivier (Juntendo Univ)

Background: Distal femoral osteotomy (DFO) improves valgus limb alignment. However, it might affect lower limb length discrepancy (LLD) and influence functional scores. This study aims to evaluate functional scores and radiographic parameters associated with LLD after DFO. It was hypothesized that the presence of LLD after DFO affects functional scores and associated with femoral length.

Methods: A total of 50 patients who underwent DFO, including 24 closed wedge (CW) DFO and 26 open wedge (OW) DFO, were included. Patients were divided into three groups according to the presence of LLD after DFO: LLD-Absent group, LLD-CW group and LLD-OW group. Patient demographics, functional scores (Knee injury and Osteoarthritis Outcome Score (KOOS)), and radiographic parameters were evaluated and compared between the three groups. Multivariable logistic regression analysis was used to assess the radiographic parameter associated with the presence of post-operative LLD.

Results: There were no significant differences between the three groups in demographic data, correction angles, complications including hinge fractures, time to osteotomy union, and functional scores. However, the return to sports (RTS) was significantly different between three groups. By further analysis between CWDFO and OWDFO, RTS in CWDFO was faster than those in OWDFO. There were significant differences in post-operative mLDFA and Δ femur length. Additionally, post-operative mLDFA was significantly associated with the presence of LLD (Odds ratio 0.11, 95% CI 0.01 to 0.49, p= 0.03).

Conclusion: Functional scores and postoperative outcomes following DFO were not affected by the presence of LLD. RTS is independent of LLD, but rather dependent on the surgical procedure and RTS in CWDFO was faster than those in OWDFO. Postoperative mLDFA is the radiographic parameter associated with the presence of LLD. These findings are clinically relevant and should be accounted for in preoperative planning of DFO.

Open wedge proximal tibial osteotomy with tibial tubercle osteotomy for severe varus deformity of tibia.

Yamada N(Yokohama sekishinkai hospital)

Introduction

Open wedge high tibial osteotomy for severe varus knee accompanies the problem of increased patellofemoral pressure, due to a relative decrease in patellar height, which is a risk for patellofemoral osteoarthritis. On the other hand, in case of open wedge distal tuberosity tibial osteotomy for severe varus knee, correction angle getting bigger, the more narrowing the contact area of the anterior flange, and the fixation of anteroposterior screw at the flange can be a problem. The purpose of this report is to introduce a new combination of open wedge proximal tibial osteotomy and tibial tubercle osteotomy that can address these issues. By adjusting height and angle of the tibial tubercle fragment, this method allows for the maintenance of contact at the flange and secure fixation of the screw, while avoiding increasing patellofemoral pressure.

Patients and methods

This case series includes three patients with knee osteoarthritis. The mean age is 54 years old and preoperative medial proximal tibial angle was 75.3 degree. All cases have a dilatation distance of 20 mm or more in case of open wedge high tibial osteotomy. Thus, open wedge proximal tibial osteotomy combined with tibial tubercle osteotomy was performed.

Results

The average MPTA improved from 75.3 degree to 92.3 degree postoperatively, and the average mechanical axis from -8.9 % to 54.3 %. Caton-Deschamps index did not change postoperatively. All cases showed improvement in VAS, and KOOS.

Conclusion

Open wedge proximal tibial osteotomy combined with tibial tubercle osteotomy was performed for severe varus deformity of the proximal tibia. Although the observation periods were short term, improvements in the postoperative alignment, knee pain, and function were obtained. This method is thought to be useful for severe tibial varus deformity especially when the big correction is required in tibial posterior slope or when the leg is shortened.

Korea e Poster

Risk of revision in UKA versus HTO: a nationwide propensity score-matched study

Yoo JD, Huh MH, Shin YS (Ewha Womans Univ)

Introduction: Our study aims to investigate the incidence rate and risk factors for subsequent revision in patients treated with UKA compared with those treated with HTO.

Methods: In this retrospective nationwide cohort study, we used data from the Korean National Health Insurance claims database from January 1, 2009 to December 31, 2017. We compared patients who had undergone UKA or HTO as the primary surgical procedure longer than two years prior. We used multivariable logistic regression models to compare risk of revision between the groups after propensity matching with inverse probability of treatment weighting (IPTW). Revision was defined as conversion to total knee arthroplasty (TKA) after primary UKA or HTO.

Results: In this study, 73,902 patients with UKA and 72,215 patients with HTO were identified after applying IPTW. The risk of revision during the entire study period was higher for patients with HTO than for patients with UKA (adjusted hazard ratio [HR] = 1.42). Kaplan-Meier 8-years survival was 96.8% in the UKA group and 95.1% in the HTO group. Patients with HTO who were at higher risk of revision had advanced age (60-69 years [HR = 2.17, 95% CI 1.76-2.67] and 70-79 years [HR = 2.89, 95% CI 1.81-4.62]), female sex (HR = 1.41, 95% CI 1.19-1.66), CHF (HR = 3.12, 95% CI 1.25-7.78), COPD (HR = 1.68, 95% CI 1.34-2.10), PVD (HR = 1.75, 95% CI 1.10-2.78), and CVA or TIA (HR = 1.87, 95% CI

1.13-3.08) compared with those with UKA.

Conclusion: Risk of revision was higher for patients with HTO than for patients with UKA. Risk factors for subsequent revision in patients with HTO were advanced age (60-69, 70-79), female sex, and comorbidities such as CHF, COPD, PVD, CVA, or TIA. However, orthopedic surgeons should also consider that TKA conversion from UKA has higher risk of revision than TKA conversion from HTO before choosing between UKA and HTO.

The use of medial joint opening rather than mechanical axis deviation to determine the clinical outcomes after high tibial osteotomy

Ryu BY, Kim SE, Kwak JP, Ro DH, Lee MC, Han HS (Seoul National Univ)

Purpose: The aim of this study was to evaluate whether achieving medial joint opening, as measured by the change in the joint line convergence angle (ΔJLCA), is a better predictor of clinical outcomes after high tibial osteotomy (HTO) compared with the mechanical axis deviation, and to find individualized targets for the redistribution of load that reflect bony alignment, joint laxity, and surgical technique.

Methods: This retrospective study analyzed 121 knees in 101 patients. Patient-reported outcome measures (PROMs) were collected preoperatively and one year postoperatively, and were analyzed according to the surgical technique (opening or closing wedge), postoperative mechanical axis deviation (deviations above and below 10% from the target), and achievement of medial joint opening (ΔJLCA > 1°). Radiological parameters, including JLCA, mechanical axis deviation, and the difference in JLCA between preoperative standing and supine radiographs (JLCAPD), an indicator of medial soft-tissue laxity, were measured. Cut-off points for parameters related to achieving medial joint opening were calculated from receiver operating characteristic (ROC) curves.

Results: Patients in whom the medial joint opening was achieved had significantly better postoperative PROMs compared with those without medial opening (all $p < 0.05$). Patients who were outliers with deviation of > 10% from the target mechanical axis deviation had significantly similar PROMs compared with patients with an acceptable axis deviation (all $p > 0.05$). Medial joint opening was affected by postoperative mechanical axis deviation and JLCAPD. The influence of JLCAPD on postoperative axis deviation was more pronounced in a closing wedge than in an opening wedge HTO.

Conclusion: Medial joint opening rather than the mechanical axis deviation determined the clinical outcome in patients who underwent HTO. The JLCAPD identified the optimal postoperative axis deviation necessary to achieve medial joint opening. For patients with increased laxity, lowering the target axis deviation is recommended to achieve medial joint opening. The target axis deviation should also differ according to the technique of undergoing HTO.

Postoperative Decrease In Bone Marrow Lesion Associated with Better Clinical Outcomes Following Medial Open-Wedge High Tibial Osteotomy

Kim JH, Kim KI (Hallym univ)

Purpose: The aim of the current study was to assess serial changes of preoperative bone marrow lesion(BML) following medial open-wedge high tibial osteotomy(MOWHTO) up to 2 years and evaluate whether postoperative change of BML affected patient-reported outcome measures(PROMs) till the 2 years follow-up. Factors related to the postoperative changes in BML were also evaluated.

Methods: Current study retrospectively assessed prospectively collected data of consecutive patients between December 2016 and March 2018 who underwent MOWHTO for symptomatic knee osteoarthritis with varus malalignment(≥5°) and minimum 2-year follow-up. Serial MRIs at preoperative and postoperative 3, 6, 18, and 24 months were performed and the extent of BML was evaluated consecutively using two validated methods. Clinically, preoperative and postoperative PROMs and their achievement of minimal clinically important difference(MCID) values were evaluated. The associations of the extent of BMLs with PROMs at each follow-up period over time were analyzed using a linear mixed model. Furthermore, factors related to the postoperative changes of BML were assessed.

Results: Of 26 patients, 21(80.8%) had preoperative BML at medial femoral and tibial condyles. The postoperative decrease in BML was noted in 17(81.0%) and 18(85.7%) at medial femoral and tibial condyles. The BML decreased at postoperative 3 months and thereafter, the extent of BML gradually reduced until postoperative 24 months. The proportion of patients achieved MCID was 84.6% for total WOMAC scores and 80.8%, 76.9%, and 84.6% for KOOS symptom, pain, and activity of daily living subscales. Postoperative decrease in BML was significantly associated with better PROMs over postoperative 24 months. Furthermore, normo-correction(2°–5° valgus) was a significant factor for decreased BML following MOWHTO.

Conclusion: Preoperative BML gradually decreased with time following MOWHTO, and the postoperative decrease in BML related with better PROMs over postoperative 24 months. Moreover, postoperative valgus alignment was a significant factor relating the postoperative decrease of BML.

Does Degeneration of the Patellofemoral Joint After Medial Open-Wedge High Tibial Osteotomy Affect Clinical Outcomes?

Lee HB, Kim KI (Kyung Hee Univ)

Purpose: Although biomechanical and clinical studies have reported adverse effects on the patellofemoral joint after medial open-wedge high tibial osteotomy (MOWHTO), there is a paucity of literature that describes outcomes longer than midterm follow-up. We aimed to evaluate the mid- to long-term radiologic and clinical outcomes of the patellofemoral joint after MOWHTO and to assess whether radiologic deterioration of the patellofemoral joint affected clinical outcomes or survivorship after MOWHTO.

Methods: We retrospectively reviewed 170 knees that underwent MOWHTO and had a minimum 5-year follow-up. In radiologic evaluation, serial postoperative changes in the patellofemoral joint compared with the preoperative status were evaluated on the Merchant view according to the Kellgren-Lawrence grade. The American Knee Society (AKS) score, Knee injury and Osteoarthritis Outcome Score (KOOS), Kujala score, incidence of anterior knee pain, and survivorship were used to assess clinical outcomes. Using radiologic assessment of the patellofemoral joint, we divided the patients into a radiologic progression group and a radiologic nonprogression group to evaluate whether radiologic progression of patellofemoral arthritis affected long-term clinical outcomes and survivorship after MOWHTO.

Results: The mean follow-up period was 96.3 months (range, 60-163 months). Arthritic progression of the patellofemoral joint on the Merchant view was observed in 44.9%, 56.3%, 66.0%, and 84.0% of the cases at 5, 7, 9, and 11 years, respectively. Clinical outcomes such as AKS scores and KOOS significantly improved after MOWHTO (P₩.001) at the latest follow-up. The incidence of anterior knee pain was 5.3% (9/170 knees). One knee (0.6%) underwent conversion to TKA due to progressive medial osteoarthritis, so the survival rate was 99.4% at a mean follow-up of 96.3 months. Despite patellofemoral degeneration over time, there were no significant differences in clinical outcomes or survivorship between patients with and without radiologic progression at the latest follow-up.

Conclusion: Although degeneration of the patellofemoral joint was observed with time after MOWHTO, the related symptoms were minimal and arthritic changes in the patellofemoral joint did not affect the clinical outcomes or survivorship after MOWHTO over a mid- to long-term follow-up.

Key Word: medial open-wedge high tibial osteotomy; patellofemoral joint; osteoarthritis; clinical outcome; survivorship

Medial Joint Opening in the Operated Knee After Unilateral High Tibial Osteotomy: Risk of Osteoarthritis and Future Surgery in the Operated and Nonoperated Knee

Choi BS, Gimm GW, Ro DH, Lee MC, Han HS (Seoul National Univ)

Purpose: High tibial osteotomy (HTO) modifies the mechanics of the affected knee, but can affect the non-operated knee. However, no research has reported on the prognosis and risk factors related to the non-operated knee after unilateral HTO. To assess the radiologic parameters that affect osteoarthritis (OA) progression and the need for surgery in the non-operated knee following unilateral HTO, with concurrent assessment of the operated knee.

Methods: From March 2007 to December 2020, 197 patients with knee OA who underwent unilateral HTO were retrospectively investigated. Radiologic parameters, such as the Kellgren-Lawrence grade, weight-bearing line ratio, joint line convergence angle (JLCA), and joint line obliquity angle were assessed preoperatively and one year postoperatively.

Results: The mean follow-up length for the 197 patients was 5.9 ± 3.2 years for the operated knee and 5.5 ± 3.2 years for the non-operated knee. A smaller postoperative JLCA in the operated knee was a significant risk factor for OA progression ($P = .027$) and undergoing surgery ($P = .006$) in the non-operated knee. Conversely, a larger postoperative JLCA in the operated knee was a significant risk factor for OA progression ($P = .014$) and conversion to arthroplasty ($P = .027$) in the operated knee. A postoperative JLCA of greater than 1.5° ($P < .001$) and less than 3.9° ($P < .001$) was needed to reduce the risk of undergoing surgery in the non-operated knee and OA progression in the operated knee, respectively. Additionally, a pre- and postoperative change in the JLCA (ΔJLCA) between -5.6° and -1.7° ($P = .021$ and $P = .004$, respectively) was needed to reduce the risk of OA progression in both knees.

Conclusion: A large medial joint opening (a small postoperative JLCA) in the operated knee after unilateral HTO was associated with a higher risk of OA progression and surgery in the non-operated knee. Conversely, a small medial joint opening (a large postoperative JLCA) was associated with a higher risk of OA progression and conversion to arthroplasty in the operated knee. For a balanced medial joint opening, if the postoperative JLCA was between 1.5° and 3.9° or the ΔJLCA was between -5.6° and -1.7°, a favorable prognosis in both knees could be anticipated.

How to Achieve Better Intraoperative Verification of Limb Alignment?

Lee DH (Donghoon Advanced Lengthening Reconstruction Institute)

Abstract

Precise alignment during lower limb osteotomies is essential for ensuring successful surgical outcomes and long-term patient satisfaction. Intraoperative methods such as the cable method, rod method, and grid method are widely used to assess limb alignment during surgery. Each technique has its advantages and limitations; however, a critical yet often underappreciated challenge lies in the distortion caused by the angulation of the C-arm's X-ray beam. This phenomenon can introduce significant errors in the visualization and measurement of alignment, potentially affecting surgical accuracy. Despite its impact, many surgeons are either unaware of this distortion or lack strategies to mitigate it effectively.

This presentation delves into the intricacies of intraoperative alignment verification. We will also focus on how C-arm-related image distortion occurs, its effect on measurement reliability, and how it can lead to unintended postoperative malalignment if unaddressed. Practical approaches to minimizing these distortions will be discussed, including optimal positioning of the C-arm, standardization of limb positioning, and complementary techniques to improve measurement fidelity. By providing a comprehensive evaluation of these factors, this discussion seeks to empower surgeons with actionable strategies to achieve precise and reproducible alignment, ultimately improving patient outcomes in lower limb osteotomies.

Clinical outcomes and radiologic evaluation focusing on patellofemoral joint after open-wedge high tibial osteotomy for medial compartment osteoarthritis of the knee

Yang SH, Hong SH, Jang KM, Han SB (Korea Univ)

Purpose: Open-wedge high tibial osteotomy (OWHTO) is an effective treatment for medial compartment osteoarthritis of the knee, particularly in active patients. However, there is a theoretical concern that this procedure may contribute to patellofemoral (PF) joint degeneration by increasing pressure on the PF joint. Few studies have evaluated patients with follow-up periods exceeding 5 years. This study aimed to assess the long-term radiological progression of PF osteoarthritis (PFOA) and its association with clinical symptoms in patients who underwent OWHTO, with an average follow-up of 115.6 months and a minimum follow-up period of 7 years. We hypothesized that OWHTO would induce PFOA progression, potentially leading to clinical symptoms.

Methods: A retrospective review was conducted on 52 knees from 44 patients who underwent OWHTO between February 2009 and October 2016. Clinical outcomes were assessed using the Hospital for Special Surgery score, Knee Society Score, Western Ontario and McMaster score, and Bristol Patella Score. The Bristol Patella Score, which targets the PF joint, incorporates components such as anterior knee pain (AKP), patellar tenderness, and crepitus, and was considered crucial for assessing the progression of PFOA postoperatively. Radiological evaluations included weight-bearing line ratio, modified Blackburn–Peel (mBP) ratio, and posterior tibial slope. Statistical analyses were performed to assess significant changes in the clinical outcomes and radiological parameters preoperatively, postoperatively, and at the final follow-up. Additionally, we examined whether changes in radiologic parameters pre- and postoperatively were associated with PFOA progression.

Results: The mean age at surgery was 58.2 years, with a median follow-up period of 115.6 months. Significant clinical improvements were noted postoperatively, with a slight deterioration observed at the final follow-up. Radiologically, a decrease in the mBP ratio was observed in most cases, indicating patellar descent postoperatively. Progression of PFOA was noted in a considerable number of cases through radiological assessments. However, despite the radiological findings, clinical symptoms such as AKP, patellar tenderness, and crepitus were rarely observed.

Conclusion: OWHTO results in significant improvements in clinical outcomes but is associated with patellar descent and PFOA progression over time. PF symptoms were observed in only a few patients in this study. Although OWHTO may induce PFOA progression, it does not appear to have a significant clinical impact in the long term.

Keywords: open-wedge high tibial osteotomy, osteoarthritis, patellar descent, patellofemoral osteoarthritis

Uniplanar Open Wedge High Tibial Osteotomy: Surgical Techniques

Kim SJ (W Hospital)

Background: Open wedge high tibial osteotomy (OWHTO) has been recognized as a beneficial treatment for osteoarthritis of the medial compartment arthritis of the knee. Then, there are several different osteotomies, gap filling and fixation techniques are introduced by each different authors. The purpose of this study is to introduce author's unique surgical techniques for uniplanar OWHTO.

Materials and Methods: From March 2013 to November 2024, one thousand two hundred thirty five consecutive uniplanar OWHTO were done. Through medial oblique surgical incision and proximal oblique osteotomy was done by custom made osteotomies after multiple pre-drilling by 2.5 mm drill bite without using saw blade. Wedge shaped gap in osteotomy site was filled with calcium-sulfate blocks in all cases. Osteotomy was fixated by three different locking plate and screw systems using minimally invasive techniques. Medial deep soft tissue repair was done and plate and screws were covered completely by soft tissue at deep fascia level.

Results: There were no neurovascular injuries in 1,235 consecutives uniplanar OWHTO. Twenty cases of hinge breakage were found but no revision surgery was followed. Two cases of superficial wound infection with skin disruption were found and which were controlled by second look debridement and suture without removal of initially fixed hardware.

Conclusion: In OWHTO, combination of osteotomy after multiple pre-drilling, calcium sulfate block and meticulous soft tissue repair guaranteed good results without low complication rate.

Biomechanical Evaluation of a Newly Designed Locking Plate for Opening-Wedge High Tibial Osteotomy: Stress Around D-hole in the Presence of Lateral Hinge Fracture

Nha KW, Kim HS (Inje Univ), Suh DH, Hong HT, Kang KT, Kim JG, Park HJ (Korea Univ),)

Purpose This study aimed to evaluate whether the newly designed OhtoFix locking plate reduced stress around the D-hole compared to the old OhtoFix and TomoFix plates. Additionally, we sought to determine whether the new OhtoFix plate maintained its biomechanical stability in the presence of a lateral hinge fracture (LHF).

Methods A finite element (FE) model of the proximal tibia was developed using cross-sectional images from a 62-year-old Asian female. The model simulated opening-wedge high tibial osteotomy (OWHTO) with three different locking plates: the old and new OhtoFix plates, and the TomoFix plate. The peak von Mises stress (PVMS) around the D-hole and across the entire plate was analyzed to assess the biomechanical performance of the three plates..

Results The newly designed OhtoFix plate demonstrated lower stress around the D-hole compared with both the old OhtoFix and TomoFix plates. The PVMS around the D-hole was 189.5 MPa in the new OhtoFix plate, 251.5 MPa in the old OhtoFix plate, and 233.3 MPa in the TomoFix plate. Although the new plate showed a reduction in PVMS across the entire plate compared to the old OhtoFix, it did not surpass the TomoFix (Figure 1). Even in the presence of an LHF, the new OhtoFix plate showed lower stress around the D-hole compared with the old OhtoFix and TomoFix plates. The highest stress was observed with a type II LHF, with PVMS values of 218.1 MPa, 310.4 MPa, and 267.0 MPa in the new OhtoFix, old OhtoFix, and TomoFix plates, respectively (Figure 2). However, although the peak stress across the entire plate was reduced in the new plate compared with the old OhtoFix plate, it remained higher than that of the TomoFix plate. Additionally, while the location of peak stress remained at the D-hole in both the old and TomoFix plates, regardless of the presence of LHF, it shifted to the C-hole in the new OhtoFix plate (Figure 3).

Conclusions The newly designed OhtoFix plate provided improved stress distribution around the D-hole, even in the presence of an LHF, compared to the old OhtoFix and TomoFix plates. However, although it reduced peak stress around the D-hole, it did not surpass the TomoFix plate in overall stress performance across the entire plate.

Medial meniscus posterior root repair restores contact pressure and contact area to its native state even after opening-wedge high tibial osteotomy: A cadaveric biomechanical study

Park HJ(Korea Univ), Chang MJ, Kim TW, Chang CB, Bae TS, Kwak DS, Kang SB(Seoul National Univ)

Purpose This study aimed to elucidate the effect of medial meniscus posterior root (MMPR) repair during opening-wedge high tibial osteotomy (OWHTO) in terms of contact pressure (CP) and contact area (CA).

Methods Nine fresh-frozen human cadaveric knee specimens were included. Each specimen was tested under nine conditions comprising 3 different degrees of correction during OWHTO (neutral, 5° of valgus, and 10° of valgus) and 3 different types of MMPR conditions (intact, torn, and repaired). The prepared specimens were attached to a customized tibiofemoral jig in a fully extended state. The CP and CA generated by a tibiofemoral axial load of 650 N was recorded using the Tekscan sensor's pressure mapping software. Statistical analysis was performed using a repeated measures analysis of variance.

Results The increased CP and decreased CA in torn MMPR was decreased and increased, respectively to the intact MMPR after repairing, irrespective of whether OWHTO was performed. The mean CP at a correction angle of 5° of valgus was 0.4067 ± 0.0768 MPa for intact MMPR, which increased to 0.7340 ± 0.1593 MPa for the torn MMPR and decreased to 0.3614 ± 0.0639 MPa for the repaired MMPR. In addition, the proportion of decrease in CP and increase in CA after MMPR repair was constant, compared to the torn MMPR, irrespective of the degree of correction during OWHTO.

Conclusion MMPR repair decreases CP and increases CA, irrespective of whether OWHTO is performed. The biomechanical advantage of repairing torn MMPR is maintained, regardless of the degree of correction during OWHTO.

Cartilage Regeneration and Long Term Survival in Medial OA Knee Patients Treated with HTO and OATS

Jung WH, Vaibhav Sahu, Seo MS(Murup Hospital), Takeuchi R(Yokohama City Univ)

Background: Osteoarthritis (OA) of the knee, in most instances primarily, affects medial compartment of knee. Combining Osteochondral Autologous Transfer (OAT) with High Tibial Osteotomy (HTO) may represent an integrated approach to sustaining long-term knee functionality in OA patients.

Materials and methods: From 2009 to 2016, combined OATS and MOWHTO was performed in 66 knees of 63 patients with medial compartment knee OA. Cartilage regeneration was assessed by 2nd look arthroscopy and Knee function was assessed by knee society scoring (KSS) pre-operatively and post-operatively. The survival rates of this combined procedure were evaluated. Failure is defined as conversion to total knee replacement.

Results: The KSS knee score (from 48.3 to 90.4) and function score (from 42.6 to 88.7) showed a statistically significant improvement (with a p-value of <0.0001) at a mean follow-up of mean 9.49 years. Second look arthroscopy done at the time of implant removal showed 100% cartilage regeneration with even hyaline cartilage regeneration in 49 out of 57 knees assessed and partial regeneration in 8 knees. The Kaplan Meier survivorship analysis was 96.7% at the mean 9.49 years after surgery. Only 2 patients needed TKA conversion in follow-up.

Conclusion: Combining OATs and valgus MOWHTO provides good option to successfully treat patients with OA and varus malalignment. This resulted in significantly improved knee function, decreased pain intensity, good cartilage regeneration, and a high survivorship rate for 10 years postoperatively.

Keywords: high tibial osteotomy; HTO; osteochondral autologous transfer system; OATS; varus malalignment; knee osteoarthritis.

Tibial Nerve injury in Medial Open Wedge-High Tibial Osteotomy - A rare complication with 14-year follow-up

Jung WH, Seo MS, Aniket Wagh(Murup Hospital)

BACKGROUND: Medial Open Wedge-Hight Tibial Osteotomy (MOW-HTO) is a standard procedure for treating moderate varus arthritis in active adults. The reason for its popularity is having lesser complications than other types of HTO. However, it is not devoid of challenges. We report tibial nerve injury in a MOW-HTO which is a rare complication not reported much in the past.

CASE PRESENTATION: A 56 years old female was operated with MOW-HTO using TomoFix plate for medial joint arthritis and varus malalignment. She developed signs of tibial nerve injury namely inability to flex the great toe and paraesthesia over posterolateral leg and sole of foot. The Nerve Conduction Velocity Study confirmed tibial nerve damage with moderate Axonotmesis. Patient was treated conservatively with electrical stimulation, interferential current therapy, physiotherapy and pregabalin. The osteotomy outcome was good with complete union and good angle correction. At the end of 14 years, the motor function was fully recovered, but the patient still had residual paraesthesia. After eliminating all other possible causes, the authors concluded that the aetiology of the nerve damage was stretch injury. Smaller incisions are related to excessive retraction leading to unreasonable stretching of the soft tissues and nerves. To avoid such injuries during MOW-HTO, the authors propose an adequate length of incision along with other steps like subperiosteal Hohmann placement to protect neurovascular structures, flexing the knee during the procedure, maintaining posterior position of the plate, and using proper size screws. The main goal of this study is to make surgeons conscious about this rare but possible complication of MOW-HTO.

Correlation of Detachment of Proximal Tibia Superficial Medial Collateral Ligament and Medial Meniscus Extrusion with Knee Osteoarthritis

Jung WH, Aniket Wagh, Seo MS, Kishor Kunal (Murup Hospital)

OBJECTIVE: To assess the correlation of detachment of proximal tibia superficial Medial Collateral Ligament (sMCL) and Medial Meniscus (MM) extrusion with knee osteoarthritis (OA) and its progression.

MATERIALS AND METHODS: Prospective study where 165 knees were evaluated using radiographs and Magnetic Resonance Imaging (MRI) for severity of OA knee according to Kellgrence- Lawrence grading (K-L), MM extrusion and status of proximal tibia attachment of sMCL. Chi square test of Independence and Pearson's Correlation test were used to assess any correlation amongst the variables.

RESULTS: The study population had a mean age of 52.93 +/- 19.46 years. 106 (64.24%) were males and 59 (35.75 were females. There were 83 (50.30%) left knees and 82 (49.70%) right knees in the study. The percentage of proximal tibia sMCL detachment was more in patients with knee OA than those without OA (85 - 88.89%). Similarly, the percentage of MM extrusion was maximum in advanced arthritis patients (95%). Both these variables were lowest in non-arthritic group (2.56% and 6.41% respectively). Statistical analysis showed a significantly positive correlation of detachment of proximal tibial attachment of sMCL as well as MM extrusion with grades of OA of knee (p value <0.001 for both).

CONCLUSION: A detached proximal tibia sMCL and an extruded Medial Meniscus were individually found to have a strong association (Chi square test) and a positive linear correlation (Pearson's test) with the arthritic condition of the knee. This would suggest a role of both these variables in the progression of knee OA. They can thus be used as prognostic markers for knee OA as well as an important target in the management of knee OA.

Mucoid Degeneration of the Anterior Cruciate Ligament is Associated with Intermediate-term Outcomes after High Tibial Osteotomy: A Propensity Score-Matched Analysis

Yang HY, Park CJ, Cheon JH, Jeong WJ, Seon JG(Chonnam National Univ)

Purpose: Mucoid degeneration (MD) of the anterior cruciate ligament (ACL) is a well-recognized pathology characterized by collagen fiber degradation and infiltration of a mucoid substance, which may be a precursor of knee osteoarthritis. The purpose of this study was to elucidate the association between progressive MD-ACL and intermediate-term outcomes after high tibial osteotomy (HTO) for medial compartment knee osteoarthritis.

Methods: We identified 423 patients who underwent HTO for medial compartment osteoarthritis with intact ACL between January 2015 and September 2022, followed by second-look arthroscopy at a 6.5 year (2.0 to 9.7) mean follow-up. Patients who had progressive MD-ACL at the time of second-look arthroscopy were included in the MD-ACL group, and those who had normal ACL were included as controls. After propensity score matching based on age, sex, body mass index, time interval between the HTO and second-look arthroscopy, 43 patients in each group were successfully matched. Clinical outcomes were assessed using the Knee Injury and Osteoarthritis Outcome Score (KOOS), International Knee Documentation Committee (IKDC), and Tegner activity scale score. Regression analyses were performed to determine potential predictive factors relevant to progressive changes of MD-ACL.

Results: Both groups had significantly improved in all clinical outcome categories at the second-look arthroscopic surgery evaluation versus baseline (all $p < 0.001$). The MD-ACL group demonstrated significantly worse postoperative clinical results in terms of KOOS subscales (pain, symptoms, and activities of daily living), IKDC, and decreased range of motion than the control group at the second-look arthroscopic surgery ($p < 0.05$). Further deterioration in clinical outcomes from the time of second-look arthroscopic surgery to latest follow-up was observed in the MD-ACL group, whereas the improvements of clinical scores maintained stable in the control group. The survival rate was 96.8% at a mean period of 6.5 year with no significant intergroup differences ($p = 0.697$; log-rank test). According to the multivariate regression analysis, smaller intercondylar notch geometry ($p = 0.003$), increased postoperative medial proximal tibial angle ($p = 0.031$), and larger changes in posterior tibial slope ($p = 0.004$) were related to progressive MD-ACL.

Conclusions: Progressive MD-ACL was associated with worse clinical outcomes after HTO over an intermediate-term follow-up. It is important for the surgeons to take into consideration of potential predisposing factors during the procedure to prevent MD-ACL following HTO.

Association of Preoperative Tibial Varus Deformity With Joint Line Orientation and Clinical Outcome After Open-Wedge High Tibial Osteotomy for Medial Compartment Osteoarthritis

Park JG, Hong SH, Jang KM, Hand SB (Korea Univ)

Background:

The correction of lower limb deformity should be performed at the site of deformity to maintain knee joint orientation. However, the effectiveness of open-wedge high tibial osteotomy (OWHTO) for treatment of medial osteoarthritis in varus malalignment without definite tibial varus deformity has not been confirmed. This study aimed to compare the clinical and radiologic outcomes after OWHTO in patients without tibial varus deformity versus patients with tibial varus deformity after matching for confounding factors. We hypothesized that these outcomes would be inferior in patients without tibial varus deformity.

Methods:

The outcomes of 133 OWHTO operations for medial osteoarthritis in 107 patients were retrospectively reviewed after follow-up more than 2 years. The patients were divided into group 1 (tibia with varus deformity, preoperative medial proximal tibial angle [MPTA]) and group 2 (tibia without varus deformity, preoperative MPTA 85). The confounding factors, including patient characteristics, preoperative limb alignment, degree of osteoarthritis, and correction angle, were matched using propensity score matching. The radiologic parameters, including MPTA and joint line obliquity, were evaluated preoperatively, between 6 and 12 months postoperatively, and at the last follow-up. The radiologic outcomes were assessed using the medial joint space width and mechanical hip-knee-ankle angle. The clinical outcomes were evaluated by the Hospital for Special Surgery knee score, Knee Society Score (KSS), and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score. The clinical and radiologic outcomes were compared between the groups. The proportions of patients achieving improvement in the clinical outcome beyond the minimal clinically important difference (MCID) or minimally important change were compared between the groups.

Results:

After propensity score matching, 32 patients were selected for each group. The mechanical hip-knee-ankle angle was corrected without significant difference from a mean ± SD varus angle of 8.0 ± 3.3 to valgus angle of -3.2 ± 2.5 in group 1 and from varus 8.0 ± 3.6 to valgus -3.9 ± 1.7 in group 2. The preoperative joint line obliquity was greater in group 2 as compared with group 1 (2.2 ± 2.2 vs -0.4 ± 1.8, $P < .001$). With a similar 10 correction angle, the postoperative MPTA and joint line obliquity were 96.6 ± 2.5 and 5.3 ± 2.3, respectively, in group 2, which were greater than 94.0 ± 2.6 and 3.5 ± 1.8, respectively, in group 1 (both $P < .001$). The changes in joint space width and mechanical hip-knee-ankle angle were not significantly different between the groups over the follow-up period. At the last follow-up, the postoperative KSS objective score and WOMAC pain

score in terms of symptom improvement were not significantly different between groups (P = .092 and .068). However, the postoperative KSS and WOMAC functional scores were significantly worse in group 2 than in group 1 (77.3 ± 14.1 vs 84.4 ± 11.6, P = .044; 10.3 ± 9.2 vs 5.6 ± 7.2, P = .001). In group 1, 96.9% and 100% of patients showed improvements of >10 points in the KSS functional score and 15 points in the WOMAC functional score based on MCID or minimally important change. Meanwhile, 65.6% and 81.3% of patients in group 2, which were significantly lower than those of group 1, were improved beyond the MCID or minimally important change (P = .001 and .024, respectively).

Conclusion:

In varus malalignment, the knee joint line was more oblique in patients without tibial varus deformity after OWHTO pre- and postoperatively. The clinical outcomes in terms of functional scores were inferior in patients without tibial varus deformity. However, the radiologic outcomes and symptomatic improvement after OWHTO were comparable regardless of the preoperative tibial varus deformity on midterm follow-up.

Combination of Cylindrical Autologous Bone Grafting Technique With a Metallic Block Insertion in Open-Wedge High Tibial Osteotomy

Kim JH (Samsung Orthopaedic Clinic)

Open-wedge high tibial osteotomy (OW-HTO) is an effective surgical intervention for medial-compartment knee osteoarthritis. However, the osteotomized gap might be a disadvantage in OW-HTO because it can cause prob- lems such as delayed bone union or loss of correction. These issues can be minimized by using autologous bone graft in the osteotomized gap, which is known to be the fastest and most clinically satisfactory gap filler. The primary mechanical stability of the osteotomy site in OW-HTO is essential for early weight bearing after surgery. Therefore, we introduce the combination of a cylindrical autologous bone grafting technique and a metallic block insertion for faster bone union and better primary stability of the site in OW-HTO. We expect that the described procedure will enable early postoperative weight bearing and, thereby, allow an early return to normal function

Optimizing Plate Fixation Position for Biomechanical Stability in Medial Opening-Wedge High Tibial Osteotomy: A Finite Element Analysis

Moon HS (Yonsei Univ), Youn JH, Lee SJ (Inje Univ), Kwak DK, Kim SH, Yoo JH(Hallym Univ)

Purpose: This study aimed to analyze the biomechanically optimal plate fixation position in MOWHTO through finite element analysis (FEA).

Materials and Methods: Utilizing the CT images of a 67-year-old male, a three-dimensional model of the knee, along with an implant (TomoFix standard plate and screws), were created to simulate a virtual MOWHTO with a 10° medial opening gap. Subjected to physiologic loading simulating a one-legged stance, biomechanical stability analysis of the bone-implant construct was conducted through FEA, with varied plate positions. Configurations for plate fixation, determined by anterior-posterior depth and height, resulted in a total of 9 fixation positions (anterior, central, and posterior in terms of depth; proximal, middle, and distal in terms of height). Criteria for assessment included inter-fragmentary micromotion at the medial opening gap, mean stress on the bone and implant, stress shielding effect, and peak von Mises stress (PVMS).

Results: The inter-fragmentary micromotion at the medial opening gap exhibited a tendency to decrease as the fixation position of the plate moved posteriorly and proximally, observed in both axial and shear micromotion. In terms of the mean stress imposed on both bone and implant, it decreased when the plate was positioned posteriorly and proximally, and this position was deemed favorable from the perspective of the stress shielding effect. PVMS predominantly occurred at Hole 1 of the plate and its corresponding screw, and it was lower than the yield strength of the titanium alloy regardless of the plate's position.

Conclusion: Placing the plate as posterior and proximal as possible emerged as the biomechanically optimal strategy in MOWHTO, in terms of minimizing inter-fragmentary micromotion, reducing stress on bone and implant, and enhancing stress shielding without the risk of implant breakage.

Clinical outcome and complications after simultaneous bilateral medial open wedge high tibial osteotomy

Kim SG(National Medical Center), Kim HS, Kim JM, Tulyapruek tawonsawatruk, Nha KW(Inje Univ)

Background: The literature provides limited evidence regarding postoperative outcomes and complications following simultaneous bilateral medial opening-wedge high tibial osteotomy (MOWHTO). This study aimed to investigate the clinical outcomes and complications associated with simultaneous bilateral MOWHTO.

Methods: We retrospectively evaluated 72 knees from 36 patients (mean age, 58.6 ± 8.2 years) who underwent simultaneous bilateral MOWHTOs between December 2011 and January 2021. Locking compression plates were used for simultaneous bilateral MOWHTOs. The Oxford Knee Score (OKS) was used to assess clinical outcomes at the last follow-up. Complications (lateral hinge fracture [LHF], nonunion, and loss of correction) were evaluated using postoperative serial plain radiography and computed tomography (CT).

Results: At the last follow-up (range, 2.0–11.1 years), the mean OKS for the 72 knees was 36.8 ± 10.4. According to the OKS, 42 knees (58.3%) scored 'excellent', 16 (22.2%) scored 'good', 8 (11.1%) scored 'moderate', and 6 (8.3%) scored 'poor'. LHFs occurred in 11 of the 72 knees (15.3%). Among these, five LHFs were identified on postoperative plain radiographs and CT scans (acute LHFs), whereas six fractures were identified only on follow-up plain radiographs (delayed LHFs). Loss of correction occurred in one patient with delayed LHFs. The patient required an additional surgical treatment to achieve bone healing at the osteotomy site.

Conclusion: Simultaneous bilateral MOWHTO is a viable treatment option for patients with bilateral medial osteoarthritis of the knee joint. Serial plain radiographs at short-term intervals are recommended to detect delayed LHFs and prevent complications such as fixation failure and loss of correction.

Hybrid Lateral Closed-Wedge High Tibial Osteotomy Showed Similar Accuracy in Angular Correction and Reduction of Posterior Tibial Slope Compared to Opening-Wedge High Tibial Osteotomy: A Correction Angle Matched Cohort Study

Jung SJ, Rhee SJ(Busan National Univ)

Background: We aimed to compare the accuracy of applied correction angle between hybrid lateral closed wedge high tibial osteotomy (hybrid HTO) and medial open wedge high tibial osteotomy (OWHTO), and verify previous reports on hybrid HTO by matching correction angle between groups. Change in various radiological parameters including union rate were also compared.

Methods: A total of 50 OWHTO patients were selected for 2:1 propensity matching with 25 hybrid HTO patients. Rate of correction error was calculated by dividing the difference between the change in medial proximal tibial angle and preoperatively planned correction angle (PRD) by planned correction angle. Accuracy of angular correction was assessed using PRD and correction error rates. Hip-knee-ankle axis, mechanical lateral distal femoral angle, medial proximal tibial angle, joint line convergence angle, and length of the entire lower limb and tibia were measured. The Caton-Deschamps index (CDI)was used to assess change in patellar height. Serial postoperative radiographic analysis was performed to assess the union rate.

Results: The discrepancy between planned correction angle and real correction angle was 0.8 ± 2.3 in hybrid HTO and 1.1 ± 3.4 in OWHTO ($P > .05$), and the rate of error in osteotomy was similar between the groups approximately 6%. Postoperatively, posterior tibial slope (PTS) ($P < .001$), tibia length, and CDI ($P < .001$) were significantly different between groups. The amount of change in PTS ($P < .001$), tibia length in hybrid HTO ($P < .001$), and CDI ($P < .001$) were significantly different between groups. Union rate of osteotomy site was significantly faster in hybrid HTO than in OWHTO ($P < .001$).

Conclusion: Hybrid HTO showed similar accuracy in angular correction compared to correction angle matched OWHTO. Reduction in PTS, tibial shortening, maintained patellar height relative to the proximal tibia, and faster osteotomy site union were also confirmed in hybrid HTO.

Alignment Changes after Open-Wedge High Tibial Osteotomy May Yield the Offloading in the Patellofemoral Joint : A SPECT/CT Analysis

Sim JA, Lee BH (Gachon Univ)

Purpose: The patellofemoral (PF) joint might be adversely affected by medial open-wedge high tibial osteotomy (OWHTO). This study aimed to evaluate PF compartmental changes using combined single-photon emission computed tomography and conventional computed tomography (SPECT/CT) after OWHTO, a technique that provides clinical guidance about PF joint pressure and force.

Methods: Fifty-three consecutive patients (56 knees) with medial osteoarthritis and varus malalignment >5° were treated using OWHTO. Patients with a minimum of 2-year follow-up period were eligible for inclusion. Radiographic parameters presenting patellar positions were evaluated. Chondral lesion changes in a second-look arthroscopic examination were evaluated, and arthritic grading of the PF joint was also recorded on patellar Merchant radiography using the Kellgren-Lawrence classification. The PF compartmental changes in SPECT/CT after OWHTO were evaluated in all patients. Scintigraphic uptakes were graded on four scales. Patients were divided into the improved and unimproved groups according to the PF compartmental grade using the SPECT/CT uptake grading system.

Results: At a mean follow-up period of 47.0 months (range, 25–74 months), the mean mechanical femorotibial angle changed significantly from varus 6.3° (range, 5–12°) to valgus 2.6° (range, 0–8°) ($p < 0.001$). Radiological parameters presenting patellar positions including tibial slope, patellar convergence angle, and lateral tilt angle did not show significant changes at preoperative versus 2-year follow-up. However, patellar height was significantly decreased (mean difference, 0.07 ± 0.14, $P = 0.001$ in the Blackburn–Peel index; 0.32 ± 0.23, $P < 0.001$ in the modified Insall-Salvati ratio). The average tibial tubercle to trochlear groove (TT-TG) distance was significantly decreased from 14.1 mm to 12.2 mm ($p < 0.001$). Q angle also was significantly decreased from 9.8o to 7.7o ($p = 0.008$). Chondral lesions of the patella and trochlear groove revealed significant deterioration; at 2 years after OWHTO, radiographically arthritic grades of the PF joints worsened significantly ($p = 0.007$). Meanwhile, scintigraphic uptake in the PF joint was significantly lower at 2 years postoperative than after the index operation (from 2 to 1) ($p < 0.001$). Only four of 56 patients (7.1%) showed increased uptakes. Comparing between the improved and unimproved groups classified by scintigraphic uptake changes, changes in the cartilage status on the patellar undersurface and TT-TG distance were the most significant predictive factors of increased scintigraphic uptake in the PF joint after OWHTO.

Conclusion: Alignment correction by OWHTO may yield the offloading in the PF compartment and should be considered in the determinations of surgical indications of OWHTO.

Offloading effect in the Unoperated Contralateral Knee after Unilateral Medial Open Wedge High Tibial Osteotomy : A SPECT/CT Analysis

Sim JA, Lee BH (Gachon Univ)

Background: An open wedge high tibial osteotomy (OWHTO) may lead to gait alteration, which change the contact loading in the contralateral knee, while clear evidence about the impact on contralateral knee still lacks. The purpose of the current study was to evaluate the change in scintigraphic uptake using SPECT-CT in the medial compartment of the contralateral knee following OWHTO.

Methods: Contralateral radiographic measurements were performed for patients with medial osteoarthritis and varus malalignment of > 5° treated with OWHTO in this retrospective analysis. The medial compartmental changes according to SPECT/CT analysis before and 1-year after OWHTO were evaluated on the contralateral side.

Results: The study comprised 72 patients. The mean preoperative mechanical femorotibial angle was a mean varus of 7.6° (range, 5.1° – 13.0°), corrected to a mean valgus of 2.5° (range, 1.9° – -8.5°) postoperatively. The average grading of the scintigraphic uptakes in the medial compartment of the contralateral knee was significantly decreased 1 year postoperatively than after the surgery (from 2.8 ± 0.4 to 2.1 ± 0.6, $p < 0.001$). Measurable differences in varus alignment on radiographs of the contralateral limb were identified. The preoperative mechanical axis value decreased from 8.0° ± 2.4° to 6.7° ± 2.6° at the 3-month postoperative visit ($p = 0.011$). The overall decrease in varus alignment remained at the 2-year final postoperative follow-up.

Conclusion: Alignment correction by OWHTO results in reducing scintigraphy uptakes in medial compartment and improvement in mechanical alignment of the contralateral knee.