A Computer Simulation Study for Preserving the Tibial Posterior Slope in Open Wedge High Tibial Osteotomy

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Abstract

Objective:

To measure the medial opening gap and examine a technique for preserving the tibial posterior slope (TPS) in open wedge high tibial osteotomy (OWHTO) using computer-simulated three-dimensional (3D) surgery.

Materials and Methods:

This study included 24 symptomatic knees from 20 patients (7 men and 13 women; mean age, 67.9 years; range 54–89 years). Digital imaging and communications from computed tomography examination were applied to a 3D picture software program, and several anatomical landmarks were registered. Then, computer simulation of OWHTO as a virtual surgery was performed: the correction angle was decided to make the femorotibial angle 170° and the TPS did not differ between pre- and post-planification. The distance between the proximal and distal cortices of the medial tibia was measured at three points, which were the anterior (AD), posterior (PD), and longest (LD) distance sites in the sagittal plane, using the 3D view, and the ratios of AD/PD and AD/LD were measured. The anteromedial opening gap was compared to the posteromedial gap and the longest distance gap at the osteotomy site. Spearman's rank correlation coefficient test was used in statistical analysis.

Results:

Mean AD/PD was 0.740±0.051 (range 0.651–0.850), and mean AD/LD was 0.652±0.040 (range 0.571–0.768). The correction angle was not associated with the values of both AD/PD and AD/LD.

Conclusions:

The difference in both AD/PD and AD/LD between each patient was regarded as a significant variation. Therefore, preoperative planification with 3D computer simulation to measure AD/PD and AD/LD may be helpful to avoid a significant increase in TPS.

Keywords

Computer simulation; 3-dimensional model; tibia; tibial posterior slope; open wedge high tibial osteotomy

Introduction

High tibial osteotomy (HTO) is commonly performed for osteoarthritis of the knee located in the medial compartment. Previously, various techniques of HTO were provided and evaluated. The two major operative methods, namely, closed- (CW) and open- (OW) wedge HTO, are universally performed to correct lower extremity malalignment in the coronal plane. First, CWHTO was reported by Coventry [1,2] and used to treat knee osteoarthritis of the medial compartment. Then, OWHTO became an established surgical procedure and has been frequently used recently.

OWHTO has several advantages compared to CWHTO, such as it is needless for fibular osteotomy, has less risk of neurovascular injury, preserves bone stock, and allows easy adjustment of alignment correction [2-5]. In addition, orthopedic surgeons have suggested that OWHTO allows patients to undergo rehabilitation, including the exercise of range of motion and weight-bearing, early [6]. However, OWHTO has disadvantages, such as delayed union at the osteotomy site [3] and change in the patellar height [7-13] and tibial posterior slope (TPS) [9,11,14,15]. In OWHTO, if an unintentional increase in TPS occurs, it may cause several problems [16,17]. Dejour et al. reported that an increased tibial slope requires increased quadriceps strength to achieve full knee extension [16]. Giffin et al. reported that an increasing slope causes an anterior shift in the tibial resting position and

affects the unstable knee, which was deficient in the anterior and posterior cruciate ligaments [17]. The mechanism of increase in TPS and several techniques to avoid this increase after OWHTO have been reported [18-23]. Lee et al. explained the mechanism of increase in TPS using a mathematical approach [19]. Briefly, the position of the lateral hinge and difference between the gaps opened at the anteromedial side of the tibia and at the posteromedial side affect the increase in TPS during OWHTO. Yim et al. reported that three-dimensional (3D) navigation was more useful for preventing the increase in TPS than two-dimensional navigation [23]. According to Song et al., TPS can be maintained if the mean anterior opening gap is approximately 67% of the posterior opening gap in the navigation study [22]. However, the navigation system cannot be used regularly in all hospitals. In addition, differences in individual morphology should be considered.

In the present study, we measured the medial opening gap and examined a technique for preserving TPS in OWHTO using computer-simulated 3D virtual surgery.

Materials and Methods

The study was approved by the ethics committee of the Hamamatsu University School of Medicine.

From January 2016 to April 2017, 24 symptomatic knees from 20 patients (7 men and 13

women) with an average age of 67.9 years (range: 54–89 years) who preoperatively underwent computed tomography (CT) from the hip to ankle were included in this study. Fifteen patients were diagnosed as having osteoarthritis and five as having osteonecrosis. Ten knees with a Kellgren-Lawrence grade (KL)-3 and five knees with a KL grade -4 had knee osteoarthritis. The femoral medial condyle of three knees and tibial medial condyle of two knees had osteonecrosis.

3D data preparation

Digital imaging and communications in medicine data from CT examinations were applied to the 3D picture software program (ZedView, LEXI, Tokyo, Japan). The center of the femoral head was defined by four reference points. The functional axis of the femur in the coronal and sagittal planes was set with respect to two reference points: the center of the femoral head and center of the knee. The femoral sagittal plane was defined as the plane with the perpendicular line between the medial and lateral condyles of the femur. The functional axis of the tibia in the coronal and sagittal planes was set with respect to two reference points: the center of the bone marrow at one-third and two-thirds of the tibial shaft. The tibial sagittal plane was defined as the plane with the line from the middle of the posterior cruciate ligament to the middle edge of the patellar tendon attachment to

the tibial tuberosity. Using the ZedHTO program (LEXI, Tokyo, Japan) under ZedView, a 3D model of the lower extremity bones was created (Fig. 1).

Computer simulation of open wedge HTO

The start point of osteotomy was set at 40 mm distal from the medial tibial plateau. The hinge point was set at 15 mm distal from the lateral tibial plateau and 10 mm medially from the lateral tibial cortex (Fig. 2). Then, an opening simulation was performed under two assumptions about the correction angle and change in TPS. 1) The correction angle was defined as the femorotibial angle reached 170° (Fig. 3). 2) During that simulation, TPS was preserved; in other words, the post-planification values of TPS did not differ from pre-planification values.

Measurement of the distance at the opening site of the medial tibial cortex

Distance between proximal and distal cortexes of the medial tibia was measured at three points, i.e., the anterior distance (AD), posterior distance (PD), and longest distance (LD) sites, in the sagittal plane using the 3D view (Fig. 4). Finally, the ratios between AD and PD (AD/PD) and AD and LD (AD/LD) were measured. The anteromedial opening gap

was compared to the posteromedial gap using 3D software from CT images.

Statistical analysis

The intra-class correlation coefficient (ICC) and 95% confidence intervals (CI) values of AD/PD and AD/LD were evaluated. Two raters who were experienced orthopedic surgeons (H.K. and H.M.) performed computer simulation analysis using the standardized aforementioned method described. The intra-rater (within a rater) variability was studied, as one observer (H.M.) measured the gap at three points in each case twice after 1 month of absence. For the inter-rater (between raters) variability, AD/PD and AD/LD of all cases were independently measured by two observers. The examiners were blinded to each other's results. In addition, we evaluated the association of AD/PD and AD/LD with medial proximal tibial angle (MPTA), which was defined as the tibial plateau angle relative to the tibial mechanical axis and the correct angle for open wedge HTO using Spearman's rank correlation coefficient test. Statistical analyses were performed using IBM SPSS statistics software, version 21 (IBM Corp., Armonk, NY).

Results

Table 1 shows measured data of AD, PD, and LD of each rater. The ICCs (95% CIs) for

intra-rater errors were 0.722 (0.365, 0.879) in AD/PD and 0.645 (0.190, 0.846) in AD/LD (p=0.001 and 0.007, respectively). The ICCs (95% CIs) for inter-rater errors were 0.750 (0.431, 0.891) in AD/PD and 0.620 (0.159, 0.833) in AD/LD (p=0.001 and 0.007, respectively).

The following data were revealed as values measured by one rater (H.M.). Mean pre-simulation MPTA was 83.1° (standard deviation [SD], 3.0), and mean post-simulation MPTA was 93.2° (SD, 2.5). The mean wedge angle was 10.1° (SD, 2.8). The mean AD was 6.9 mm (SD, 2.1), mean PD was 9.3 mm (SD, 2.8), and mean LD was 10.6 mm (SD, 3.0). The mean AD/PD was 0.740 (SD, 0.051), and mean AD/LD was 0.652 (SD, 0.040). For AD/PD, the maximum was 0.850 and the minimum was 0.651. For AD/LD, the maximum was 0.768 and the minimum was 0.571.

Figure 5a, b shows the distribution of the number of patients in each range of AD/PD and AD/LD. The AD/PD revealed that the number of patients was distributed relatively widely from 0.65 to 0.85, although there were slightly large numbers from 0.70 to 0.55. Conversely, the distribution of AD/LD was from 0.60 to 0.70.

Preoperative MPTA and the correction angle were not associated with each value of AD/PD and AD/LD (Figs. 6a, b, & 7a, b).

Discussion

The results of this study showed that AD/PD and AD/LD are helpful in preoperative planning of open wedge HTO and intraoperative reference points. For preoperative planning and postoperative evaluation in HTO, simple measurements are made with radiography and classic tracing paper. The benefits of this conventional method are its simplicity, low cost, and less exposure to radiation. However, the development of digital preoperative planning for orthopedic surgery has been required, and 3D simulation software has been developed to obtain excellent postoperative outcomes.

Digital preoperative planning was developed mainly in the field of hip and knee joint arthroplasty [24-26]. In several methods of digital preoperative simulation, the ZedView has been used in Japan recently. Shimizu et al. reported that the ZedView was useful for 3D visualization of the human face and applied to facial contouring surgery using free anterolateral thigh flap transfer [27]. In orthopedic surgery, 3D simulation software related to the ZedView has been used recently [28,29].

Herein, we performed a simulation of OWHTO to measure the anterior, posterior, and maximal dilatation gaps at the osteotomy site. Song reported that TPS could be maintained if the anterior opening gap was approximately 67% of the posterior opening gap [22], which was similar to our results of AD/LD as averaged data. There was a little

161 variation in our ranges of values for AD/PD and AD/LD.

162 Previously, Lee et al. explained that the difference between the AD of the medial
163 osteotomy site and PD depends on the length from the hinge line to the medial osteotomy
164 site [19]. On the other hand, the correction angle of open HTO and the inclination of the
165 tibial plateau, which is reflected by the MPTA, were not related to those ratios, such as
166 AD/PD and AD/LD, in our study. We considered that the AD and PD of the medial
167 osteotomy site may depend on the morphology of the proximal tibia. We thought that the
168 individual difference of AD/PD and AD/LD between each patient should be considered
169 because the maximum difference was over 20% among the patients.

170 Although there was some congruity in the intra- and inter-rater errors, AD/PD had a
171 relatively larger error in both intra- and inter-rater errors than AD/LD. Furthermore, the
172 distribution of AD/PD was wide, whereas that of AD/LD was not. We considered it
173 difficult to determine the constant point as the posterior side of the medial tibia because
174 the medial posterior wall of the tibia was commonly curved, not flat. In contrast, it was
175 easy to constantly determine the LD point as the definite site. Therefore, the measurement
176 of AD/LD might be useful to preserve TPS compared with AD/PD. In fact, the point of
177 LD can be easily identified as the tip to the medial tibial cortex and tibial tuberosity, which
178 is the reference landmark for AD that can be confirmed directly during the actual surgery.

We consider that the ratio of the anterior gap compared with the posterior gap or the maximal dilatation gap varies between each patient in terms of the preservation of TPS. Therefore, we suggest that it is possible to avoid a significant increase in TPS by referring intraoperatively to AD/PD and AD/LD measured preoperatively with ZedHTO.

There were several limitations to this study. First, the use of ZedHTO software involves expenses, and the software requires annual updates. Second, this protocol requires CT scanning from the hip to the ankle joint. There may be some concerns about radiation exposure. Third, this study was based on computer simulations, which might be different from actual clinical situations. For example, in actual surgery, it is difficult to preserve the hinge point constantly. According to Takeuchi et al., fractures around the lateral cortical hinge occurred in 25% of knees [30]. However, Kendoff et al. reported that the change in axial rotation was considerable in OWHTO [31]. Therefore, clinical studies about the change in TPS are needed in the future.

In conclusion, the difference in AD/PD and AD/LD between each patient was regarded to have significant variation. Therefore, preoperative planification with 3D computer simulation to measure AD/PD and AD/LD may be helpful to avoid a significant increase in TPS.

References

[1] Coventry MB (1965) Osteotomy of the upper portion of the tibia for degenerative arthritis of the knee, a preliminary report. J Bone Joint Surg Am. 47:984-90.

[2] Coventry MB (1998) Proximal tibial osteotomy. Orthop Rev 17:456-458.

[3] Duivenvoorden T, van Diggele P, Reijman M et al (2017) Adverse events and survival after closing- and opening-wedge high tibial osteotomy: a comparative study of 412 patients. Knee Surg Sports Traumatol Arthrosc 25:895-901.

[4] Hankemeier S, Mommsen P, Krettek C et al (2010) Accuracy of high tibial osteotomy: comparison between open- and closed-wedge technique. Knee Surg Sports Traumatol Arthrosc 18:1328-1333.

[5] Lee DC, Byun SJ (2012) High tibial osteotomy. Knee Surg Relat Res 24:61-69.

[6] Nakamura E, Mizuta H, Kudo S, Takagi K, Sakamoto K (2001) Open-wedge osteotomy of the proximal tibia with hemicallotasis. J Bone Joint Surg Br 83:1111-1115.

[7] Takeuchi R, Ishikawa H, Aratake M et al (2009) Medial opening wedge high tibial osteotomy with early full weight bearing. Arthroscopy 25:46-53.

[8] Brouwer RW, Bierma-Zeinstra SM, van Koeveringe AJ, Verhaar JA (2005) Patellar height and the inclination of the tibial plateau after high tibial osteotomy. The open versus the closed-wedge technique. J Bone Joint Surg Br 87:1227-1232.

214 [9] Chae DJ, Shetty GM, Lee DB, Choi HW, Han SB, Nha KW (2008) Tibial slope and
215 patellar height after opening wedge high tibial osteotomy using autologous tricortical iliac
216 bone graft. Knee 15:128-133.
217 [10] El-Azab H, Glabgly P, Paul J, Imhoff AB, Hinterwimmer S (2010) Patellar height
218 and posterior tibial slope after open- and closed-wedge high tibial osteotomy: a
219 radiological study on 100 patients. Am J Sports Med 38:323-329.
220 [11] Hanada M, Takahashi M, Koyama H, Matsuyama Y (2014) Comparison of the
221 change in patellar height between opening and closed wedge high tibial osteotomy:
222 measurement with a new method. Eur J Orthop Surg Traumatol 24:567-570.
223 [12] LaPrade RF, Oro FB, Ziegler CG, Wijdicks CA, Walsh MP (2010) Patellar height
224 and tibial slope after opening-wedge proximal tibial osteotomy: a prospective study. Am
225 J Sports Med 38:160-170.
226 [13] Smith TO, Sexton D, Mitchell P, Hing CB (2010) Opening- or closing-wedged high
227 tibial osteotomy: a meta-analysis of clinical and radiological outcomes. Knee 18:361-368.
228 [14] Wright JM, Heavrin B, Begg M, Sakyrd G, Sterett W (2001) Observations on patellar
229 height following opening wedge proximal tibial osteotomy. Am J Knee Surg 14:163-173.
230 [15] Hohmann E, Bryant A, Imhoff AB (2006) The effect of closed wedge high tibial
231 osteotomy on tibial slope: a radiographic study. Knee Surg Sports Traumatol Arthrosc

14:454-459.

[16] Schaefer TK, Majewski M, Hirschmann MT, Friederich NF (2008) Comparison of sagittal and frontal plane alignment after open- and closed-wedge osteotomy: a matched-pair analysis. J Int Med Res 36:1085-1093.

[17] Dejour H, Neyret P, Boileau P, Donell ST (1994) Anterior cruciate reconstruction combined with valgus tibial osteotomy. Clin Orthop Relat Res 299:220-228.

[18] Giffin JR, Vogrin TM, Zantop T, Woo SL, Harner CD (2004) Effects of increasing tibial slope on the biomechanics of the knee. Am J Sports Med 32:376-382.

[19] Jo HS, Park JS, Byun JH et al (2018) The effects of different hinge positions on posterior tibial slope in medial open-wedge high tibial osteotomy. Knee Surg Sports Traumatol Arthrosc 26:1851-1858.

[20] Lee YS, Park SJ, Shin VI, Lee JH, Kim YH, Song EK (2010) Achievement of targeted posterior slope in the medial opening wedge high tibial osteotomy: a mathematical approach. Ann Biomed Eng 38:583-593.

[21] Moon SW, Park SH, Lee BH et al. (2015) The effect of hinge position on posterior tibial slope in medial open-wedge high tibial osteotomy. Arthroscopy 31:1128-1133.

[22] Noyes FR, Goebel SX, West J (2005) Opening wedge tibial osteotomy: the 3-triangle method to correct axial alignment and tibial slope. Am J Sports Med 33:378-387.

250 [23] Song EK, Seon JK, Park SJ (2007) How to avoid unintended increase of posterior
251 slope in navigation-assisted open-wedge high tibial osteotomy. Orthopedics 30:S127-
252 S131.
253 [24] Yim JH, Seon JK, Song EK (2012) Posterior tibial slope in medial opening-wedge
254 high tibial osteotomy: 2-D versus 3-D navigation. Orthopedics 35:60-63.
255 [25] Levine B, Fabi D, Deirmengian C (2010) Digital templating in primary total hip and
256 knee arthroplasty. Orthopedics 33:797.
257 [26] Sariali E, Mauprivez R, Khiami F, Pascal-Mousselard H, Catonné Y (2012) Accuracy
258 of the preoperative planning for cementless total hip arthroplasty. A randomised
259 comparison between three-dimensional computerised planning and conventional
260 templating. Orthop Traumatol Surg Res 98:151-158.
261 [27] Viceconti M, Lattanzi R, Antonietti B et al (2003) CT-based surgical planning
262 software improves the accuracy of total hip replacement preoperative planning. Med Eng
263 Phys 25:371-377.
264 [28] Shimizu F, Uehara M, Oatari M, Kusatsu M (2016) Three-dimensional visualization
265 of the human face using DICOM data and its application to facial contouring surgery
266 using free anterolateral thigh flap transfer. J Plast Reconstr Aesthet Surg 69:e1-e4.
267 [29] Kobayashi N, Inaba Y, Kubota S et al. (2007) The distribution of impingement region

268 in cam-type femoroacetabular impingement and borderline dysplasia of the hip with or
269 without cam deformity: a computer simulation study. Arthroscopy 33:329-334.
270 [30] Yoshii Y, Kusakabe T, Akita K, Tung WL, Ishii T (2017) Reproducibility of three
271 dimensional digital preoperative planning for the osteosynthesis of distal radius fractures.
272 J Orthop Res 35:2646-2651.
273 [31] Takeuchi R, Ishikawa H, Kumagai K et al (2012) Fractures around the lateral cortical
274 hinge after a medial opening-wedge high tibial osteotomy: a new classification of lateral
275 hinge fracture. Arthroscopy 28:85-94.
276 [32] Kendoff D, Lo D, Goleski P, Warkentine B, O'Loughlin PF, Pearle AD (2008) Open
277 wedge tibial osteotomies influence on axial rotation and tibial slope. Knee Surg Sports
278 Traumatol Arthrosc 16:904-910.

Figure Legends

Fig. 1

Sagittal and coronal plane images and the three-dimensional image made with ZedHTO (LEXI, Tokyo, Japan) using the left knee model.

The femorotibial angle and tibial plateau angle against the tibial mechanical axis are measured automatically.

Fig. 2

Simulation image in the left knee model.

The start point of osteotomy (green) is set at 40 mm distally from the medial plateau (*).

The hinge point (blue) is set at 15 mm distally from the lateral plateau (†) and 10 mm medially from the lateral cortex (††).

Fig. 3

Simulation image after opening the osteotomy site using the left knee model.

We defined the femorotibial angle as corrected to 170° in the current simulation.

297 Fig. 4

298 The three points defined to measure the distance at the opening site.

299 In the left knee model, the distance between proximal and distal cortexes of the medial

300 tibia is measured at three points: the anterior, posterior, and longest distance sites.

301

302 Fig. 5

303 Distribution of the number of patients by AD/PD (a) and AD/LD (b).

304 AD, anterior distance; PD, posterior distance; LD, longest distance

305

306 Fig. 6

307 Relationship between preoperative MPTA and AD/PD (a), and AD/LD (b).

308 Preoperative MPTA is not associated with AD/PD and AD/LD (coefficient of correlations:

309 -0.178 and -0.327, respectively).

310 MPTA, medial proximal tibial angle (tibial plateau angle against the tibial mechanical

311 axis); AD, anterior distance; PD, posterior distance; LD, longest distance

312

313 Fig. 7

314 Relationship between the correction angle and AD/PD (a), AD/LD (b).

315 The correction angle of OWHTO is not associated with AD/PD and AD/LD (coefficient

316 of correlations: 0.039 and 0.156, respectively).

317 AD, anterior distance; PD, posterior distance; LD, longest distance;

318 OWHTO, open wedge high tibial osteotomy;

Table 1

Measured data of AD, PD, and LD in each rater.

Rater	AD (mm)	PD (mm)	LD (mm)	AD/PD	AD/LD
H.M.	6.9 ± 2.1	9.3 ± 2.8	10.6 ± 3.0	0.740 ± 0.051	0.652 ± 0.040
H.K.	7.2 ± 1.6	9.7 ± 2.4	10.8 ± 2.5	0.753 ± 0.070	0.676 ± 0.060

Values are presented as mean and standard deviation.


MPR ビュー - Coronal [脛骨左座標系]
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R
L
B
MPR ビュー - Sagittal [脛骨左座標系]
T
A
P
B
3Dビュー - 1 [Plan-untitled 1]
ZedView Model
FemurLEFT
TibiaLEFT
Imported Model
A
ビュー座標系
脛骨左座標系
下肢区分
右
左
骨切面設置
ツール
ヒンジポイント移動
移動量
1.0
上方
下方
内側
外側
骨切面端点移動
移動量
1.0
上方
下方
内側
外側
骨切平面
骨切実行
骨切キャンセル
骨切モデル操作
カットパラメータ
表示
ウェッジ角度(度)
******
開大部長さ(mm)
******
術前アライメント
表示
大腿脛骨角(FTA)
179.30 °
mLDFA
87.84 °
MPTA
86.44 °
JLCA
3.65 °
機能軸通過位置(%MA)
22.93 %
術後アライメント
表示
矯正後FTA
******
矯正後MPTA
******
機能軸通過位置(%MA)
******
内側関節面傾斜差
******
外側関節面傾斜差
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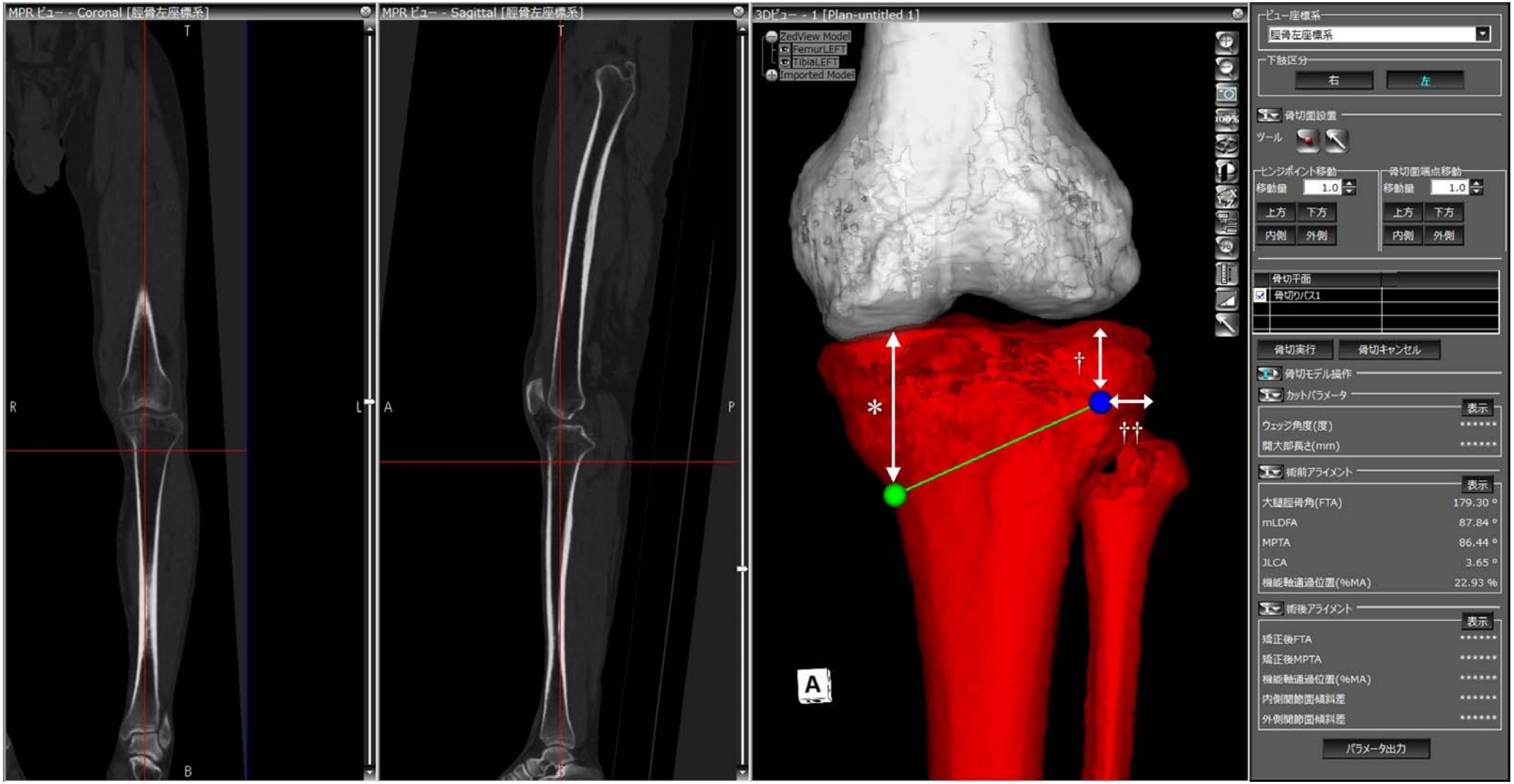
パラメータ出力


MPR ビュー - Coronal [脛骨左座標系]
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MPR ビュー - Sagittal [脛骨左座標系]
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3Dビュー - 1 [Plan-untitled 1]
ZedView Model
FemurLEFT
TibiaLEFT
Imported Model
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ビュー座標系
脛骨左座標系
下肢区分
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左
骨切面設置
ツール
ヒンジポイント移動
移動量
1.0
上方
下方
内側
外側
骨切面端点移動
移動量
1.0
上方
下方
内側
外側
骨切平面
骨切りパス1
骨切実行
骨切キャンセル
骨切モデル操作
カットパラメータ
表示
ウェッジ角度(度)
******
開大部長さ(mm)
******
術前アライメント
表示
大腿脛骨角(FTA)
179.30 °
mLDFA
87.84 °
MPTA
86.44 °
JLCA
3.65 °
機能軸通過位置(%MA)
22.93 %
術後アライメント
表示
矯正後FTA
******
矯正後MPTA
******
機能軸通過位置(%MA)
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内側関節面傾斜差
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外側関節面傾斜差
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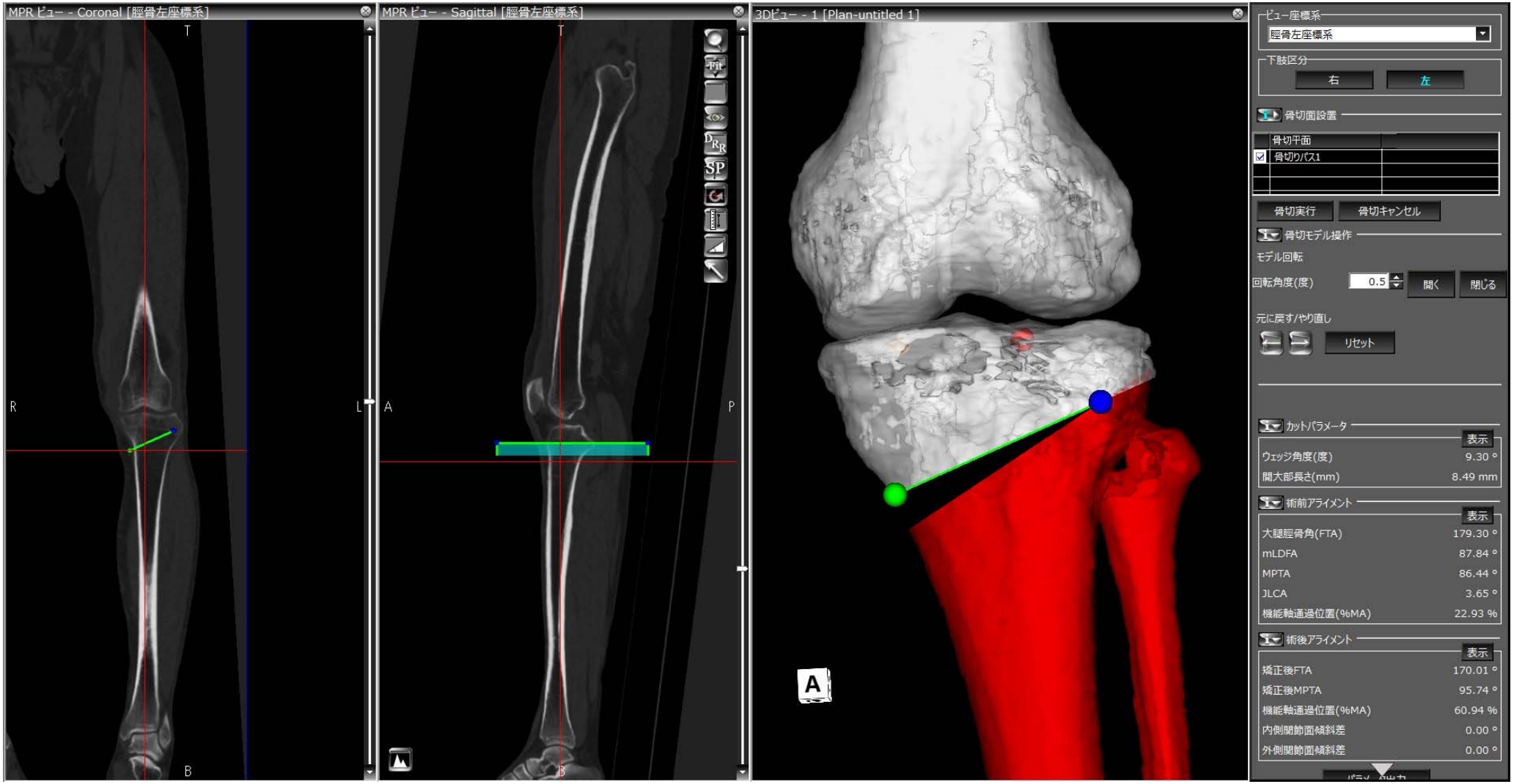
パラメータ出力


MPR ビュー - Coronal [脛骨左座標系]
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MPR ビュー - Sagittal [脛骨左座標系]
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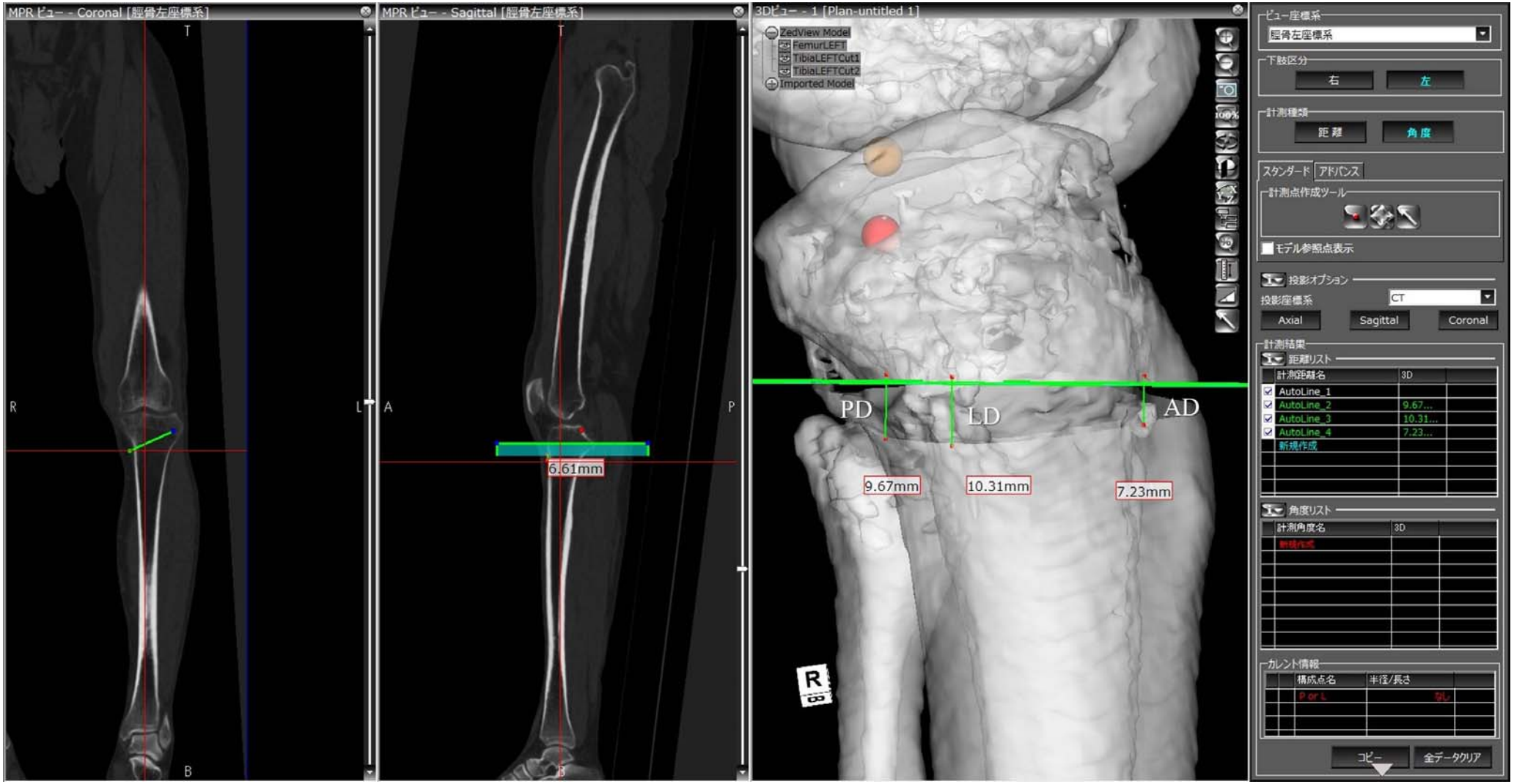
SP
3Dビュー - 1 [Plan-untitled 1]
A
ビュー座標系
脛骨左座標系
下肢区分
右
左
骨切面設置
骨切平面
骨切りパス1
骨切実行
骨切キャンセル
骨切モデル操作
モデル回転
回転角度(度)
0.5
開く
閉じる
元に戻す/やり直し
リセット
カットパラメータ
表示
ウェッジ角度(度) 9.30 °
開大部長さ(mm) 8.49 mm
術前アライメント
表示
大腿脛骨角(FTA) 179.30 °
mLDFA 87.84 °
MPTA 86.44 °
JLCA 3.65 °
機能軸通過位置(%MA) 22.93 %
術後アライメント
表示
矯正後FTA 170.01 °
矯正後MPTA 95.74 °
機能軸通過位置(%MA) 60.94 %
内側関節面傾斜差 0.00 °
外側関節面傾斜差 0.00 °


MPR ビュー - Coronal [脛骨左座標系]
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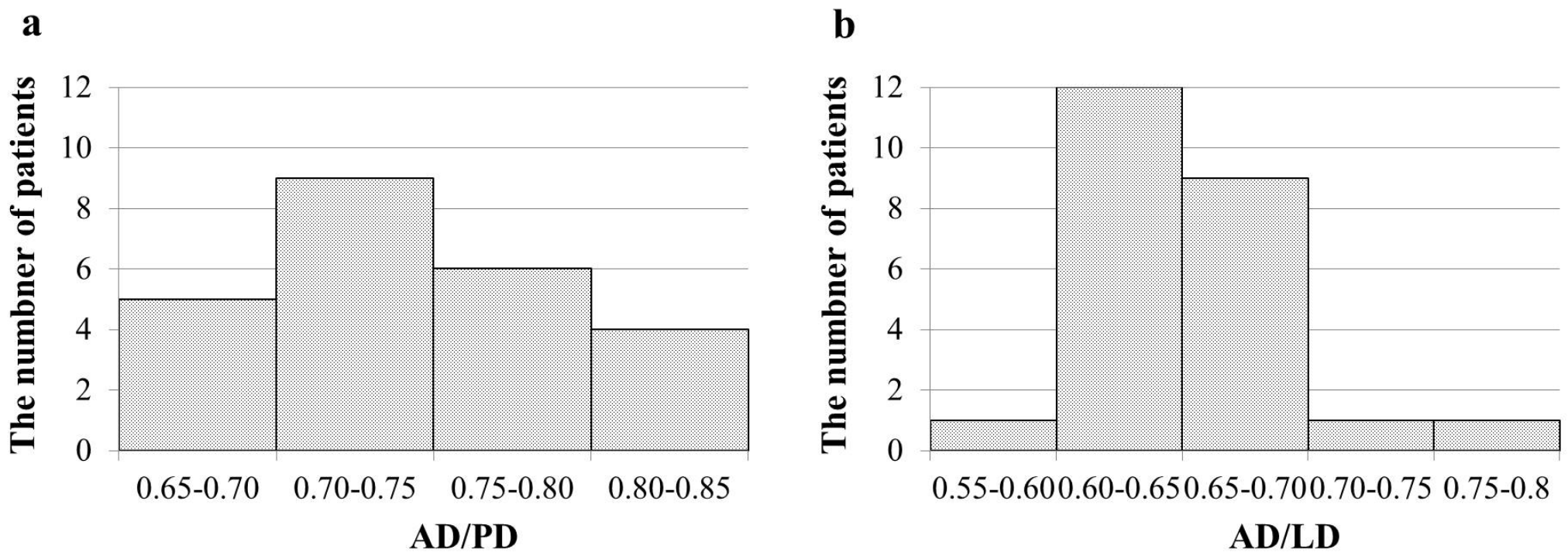
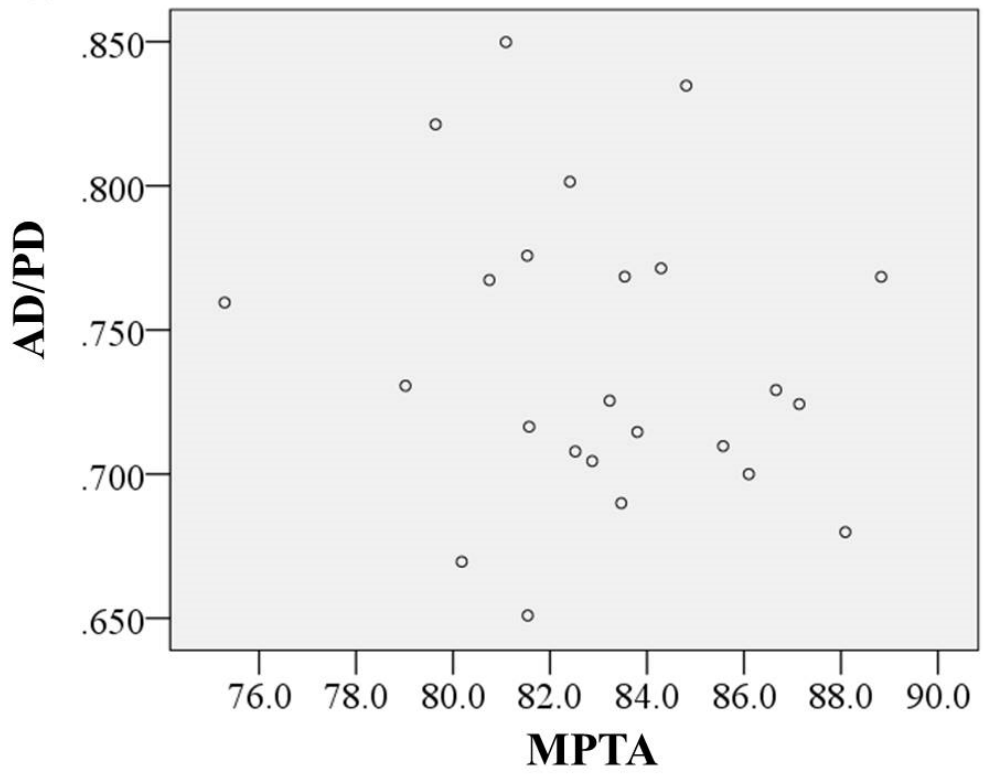
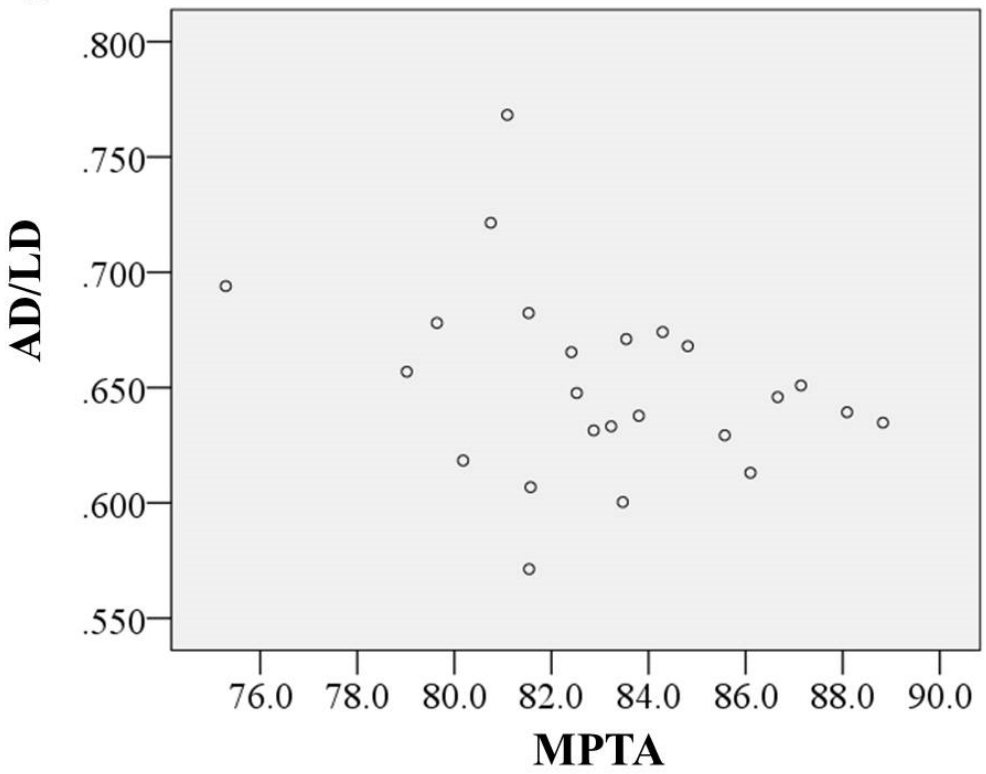
B
MPR ビュー - Sagittal [脛骨左座標系]
T
A
P
6.61mm
3Dビュー - 1 [Plan-untitled 1]
ZedView Model
FemurLEFT
TibiaLEFTCut1
TibiaLEFTCut2
Imported Model
PD
LD
AD
9.67mm
10.31mm
7.23mm
R
ビュー座標系
脛骨左座標系
下肢区分
右
左
計測種類
距離
角度
スタンダード
アドバンス
計測点作成ツール
モデル参照点表示
投影オプション
投影座標系
CT
Axial
Sagittal
Coronal
計測結果
距離リスト
計測距離名
3D
AutoLine_1
AutoLine_2
9.67...
AutoLine_3
10.31...
AutoLine_4
7.23...
新規作成
角度リスト
計測角度名
3D
新規作成
カレント情報
構成点名
半径/長さ
P or L
なし
コピー
全データクリア


a
The numbner of patients
12
10
8
6
4
2
0
0.65-0.70
0.70-0.75
0.75-0.80
0.80-0.85
AD/PD
b
The numbner of patients
12
10
8
6
4
2
0
0.55-0.60
0.60-0.65
0.65-0.70
0.70-0.75
0.75-0.8
AD/LD

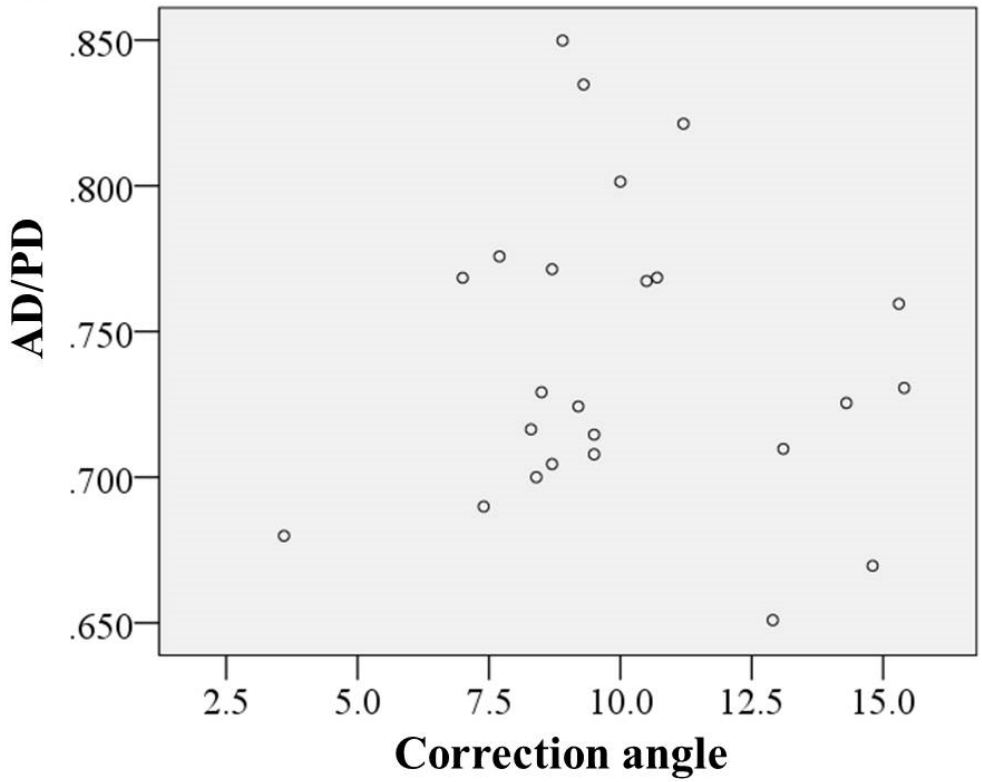
a


AD/PD
.850
.800
.750
.700
.650
76.0
78.0
80.0
82.0
84.0
86.0
88.0
90.0
MPTA

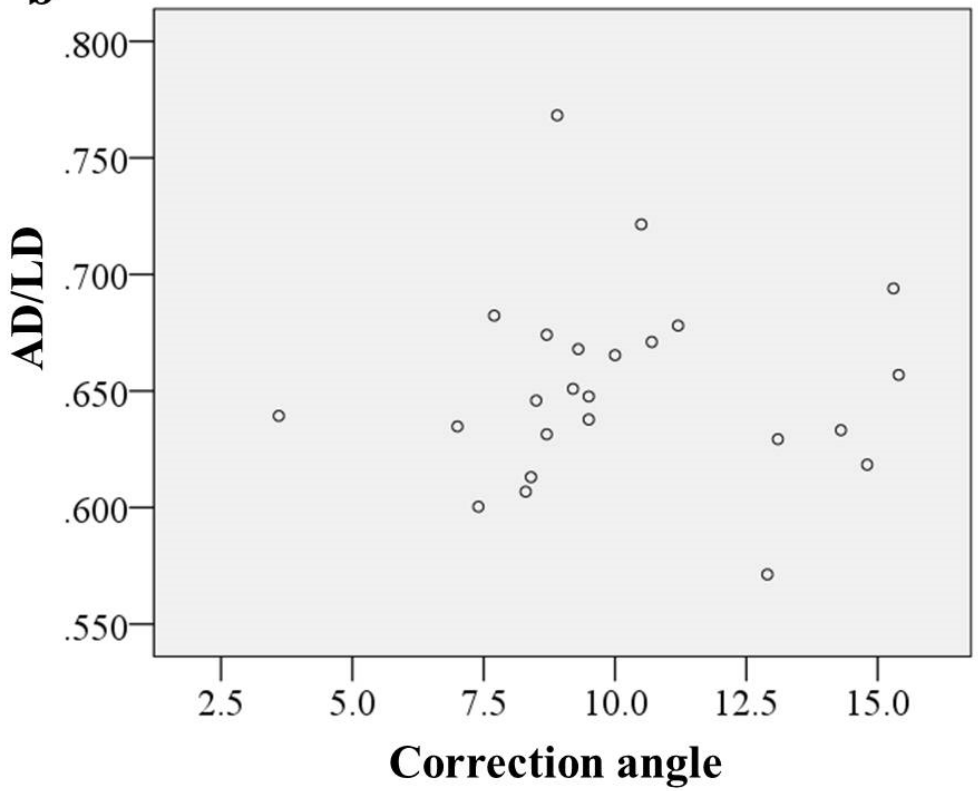
b


AD/LD
.800
.750
.700
.650
.600
.550
76.0
78.0
80.0
82.0
84.0
86.0
88.0
90.0
MPTA

a


AD/PD
.850
.800
.750
.700
.650
2.5
5.0
7.5
10.0
12.5
15.0
Correction angle

b


AD/LD
.800
.750
.700
.650
.600
.550
2.5
5.0
7.5
10.0
12.5
15.0
Correction angle