# CORIN KneeTec DeepDishTM: Functional outcomes after a follow-up of 12 months and comparison with the STRYKER Triathlon®PS

Maxime Lefèvre, Jules Cavailhès, Clément Ferri, François Sirveaux, Olivier Roche, Laurent Galois

*From Department of Orthopedic Surgery, Centre Chirurgical Emile Gallé, University Hospital of Nancy, Nancy, France*

Several competing concepts of anteroposterior stabilization have been developed for total knee arthroplasty (TKA), with an overall great success despite some differences in terms of clinical or radiological outcomes. The CORIN KneeTec DeepDish TM is a novel mobile-bearing implant, stabilized with an ultra-congruent deep-dish poly-ethylene insert. The aim of the present study was to report clinical and radiological outcomes of a series of patients who received the KneeTec DeepDish TM after a follow-up of 12 months, and to compare them to those of a comparable series of patients who received the STRYKER Triathlon® posterior-stabilized.

This was a retrospective comparative cohort study (level of evidence III). Demographic data, radiographic data and range of motion (ROM), as well the International Knee Society score and Oxford Knee Score were collected pre-operatively, and after a follow-up of 12 months.

106 KneeTec DeepDish TM and 80 Triathlon® PS were evaluated at follow-up. Patients who received the KneeTec DeepDish TM had significant improvement in ROM, radiographic and clinical outcomes. There were no significant differences between the cohorts in terms of ROM, radiographic and clinical outcomes, as well as antero-posterior stability.

This study is the first to report the 12-month outcomes of the CORIN KneeTec DeepDish TM. The novel KneeTec DeepDish TM achieved comparable ROM, radiographic and clinical outcomes to the Triathlon® PS after 12 months. Further studies will be necessary to evaluate the mid- to long-term outcomes of the KneeTec DeepDish TM .

**Keywords:** Total knee arthroplasty ; Deep-dish ; Ultra-congruent ; Functionnal outcomes ; Radiographic outcomes.

■ Maxime Lefèvre
■ Jules Cavailhès
■ Clément Ferri
■ François Sirveaux
■ Olivier Roche
■ Laurent Galois
   *Department of Orthopedic Surgery, Centre Chirurgical Emile Gallé, University Hospital of Nancy, Nancy, France.*
Correspondence : Professor Laurent Galois, M.D, 49 rue Hermite, Centre Chirurgical Emile Gallé, 54000 Nancy, Tel: 03.83.85.75.33
E-mail: l.galois@chu-nancy.fr
   © 2022, Acta Orthopædica Belgica.

## INTRODUCTION

The number of total knee arthroplasties (TKA) worldwide is increasing, in part due to the ageing of the population and the associated increasing incidence of knee arthritis. Different competing methods of anteroposterior stabilization have successfully been developed for primary TKA (1-4). Ultra-congruent (UC) TKA implants have demonstrated satisfying clinical outcomes comparable to those of other designs (5), with important advantages in terms of bone-stock conservation (6) and improved congruence (7). However, they are associated with more modest ranges of motion (ROM), especially when compared to PS implants (8), and unique kinematic characteristic (9).

Further, the UC design places high levels of tension on the tibial plateau (10), which could increase shear forces and lead to implant loosening. The CORIN KneeTec DeepDishTM is a novel implant based on the CORIN HLS KneeTecTM design (11), but stabilized using a deep-dished ultra-congruent polyethylene insert rather than the usual 3rd condyle PS. To avoid excessive pressure on the tibia, it is mounted on a mobile-bearing tibial plateau (12). To our knowledge, the results of the KneeTec DeepDishTM remain unknown, and short-term outcomes remain unknown.

The purpose of this study was therefore to report the 12-month results of the KneeTec DeepDishTM implant, including ROM, radiographic and clinical outcomes. A secondary purpose was to compare these results to those of a comparable cohort who received the STRYKER Triathlon® PS, which represents a gold-standard in PS TKA (13). The hypothesis of this study was that the novel UC implant would provide comparable outcomes to the established PS implant.

## MATERIALS AND METHODS

All consecutive patients who received the KneeTec DeepDishTM between February 2017 and December 2017 or the Triathlon® PS between January 2016 and December 2017 for primary TKA in one center were included in this retrospective comparative cohort study. The initial cohorts com-

prised 150 KneeTec DeepDishTM and 94 Triathlon® PS patients. However, patients with a history of infection, who could not understand the staff, or who could not be reached for a clinical and radiographic follow-up evaluation were excluded from the study (KneeTec DeepDishTM, 35 patients, 25.3%; Triathlon® PS, 12 patients, 12.8%). All patients provided oral informed con-sent for participation in the study. Because the study did not interfere with the planned procedures for the patients due to its retrospective nature, the institutional review board (IRB) waived approval requirements for the study.

KneeTec DeepDishTM was designed from Corin's HLS KneeTecTM 3rd condyle PS implant as an ultra-congruent antero-stabilized implant with a mobile-bearing tibial plateau. This new design aims to maintain the design of the original PS variant [11], particularly in terms of patellar tracking with the advantages of UC design (6). The KneeTec DeepDishTM is made of chrome-cobalt and is always cemented. Its femoral component has a single radius and an anatomic trochlea designed 7° in valgus to facilitate patellar tracking. An ultra-congruent tibial insert provides anterior stability with an anterior lip of 10.5 mm. Patients were operated on using the anteromedial parapatellar approach. The decision to resurface the patella was left to the operator, based on intra-operative observations.

STRYKER Triathlon® PS is postero-stabilized using a traditional post-cam system, and uses a fixed-bearing tibial plateau. This implant is considered a gold-standard in TKA, having been implanted in more than 20 million knees worldwide and the subject of numerous long-term studies (13). The Triathlon® PS is also made of chrome-cobalt, and is designed with a single radius and an anatomic trochlea. However, it is available in either cemented or uncemented versions. The majority (90%) of patients were operated on using the subvastus approach (anteromedial parapatellar approach 10%). The decision to resurface the patella was left to the operator, based on intra-operative observations.

The rehabilitation protocol was standard for both cohorts and was initiated on the day of surgery when possible. Patients were released after demonstrating their ability to walk on a flat surface

and on stairways. Patients were not immobilized, and full weight-bearing was allowed upon release. Crutches were allowed, following the patients' preference. Patients living alone were addressed to a rehabilitation center.

Demographic data and preoperative ROM, the American Society of Anesthesiologists (ASA), Devane (14) scores, were systematically collected preoperatively. Moreover, preoperative International Knee Society and Oxford Knee Scores (15) were collected from the KneeTec DeepDishTM cohort to evaluate improvement after surgery.

Further, preoperative weightbearing frontal radio graphs were used to evaluate alignment and grade the osteoarthritis of the knees according to the Ahlbäck (16) classification. Skyline radiographs were used to grade the knees according the Iwano classification (17). Knee stability was evaluated in clinic at follow-up, using a goniometer to measure frontal laxity in degrees and a clinical exam to estimate anteroposterior stability in millimeters (mm).

After a follow-up of an average of 15 months (minimum 12 months), patients were evaluated in clinic and underwent radiographic examination. Their satisfaction was noted according the Likert scale, and their ROM were measured. The IKS and OKS were collected for patients of both KneeTec

DeepDishTM and Triathlon® PS cohorts. Further, all preoperative radiographic measurements were repeated at follow-up. In addition, the patellar position was evaluated on skyline radiographs, and tibial stress-shielding was classified according to Ewald et al. (18) on frontal radiographs.

All statistical analyses were performed using SAS 9.4 (SAS Institute, Cary, NC). The normality of variable distribution was evaluated using the Shapiro-Wilk test. Quantitative variables were analyzed using Student's T-Test for parametric variables or the Mann-Whitney U test for non-parametric variables. Categoric variables were analyzed using the Chi-squared test for normally distributed variables or Fisher's exact test for non-normally distributed variables. A p-value of 0.05 was considered significant ($\alpha=0.05$).

## RESULTS

In the KneeTec DeepDishTM cohort, 3 patients died during follow-up, independently of their TKA, and 2 patients had revision surgery (Figure 1). The first was due to bilateral surgical site infections resulting in hematogenous translocation. The second was due to subluxation of the polyethylene insert. In the Triathlon® PS cohort, 1 patient died during follow-up, independently of his TKA, and 1 patient

*Figure 1.* — Flowchart detailing patient inclusion.
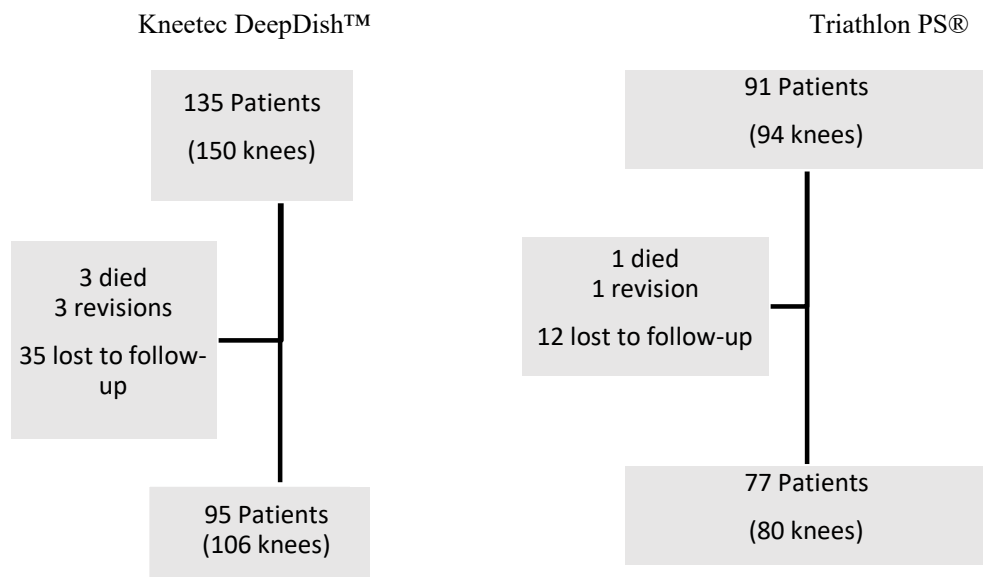
had revision surgery due to implant failure. The final cohorts comprised 106 KneeTec DeepDishTM (95 patients) and 80 Triathlon® PS (77 patients). Median follow-up in the Kneetec cohort was 16 months (IQR, 14-19 months), compared to 27 months (IQR, 20-35 months) in the Triathlon® cohort (p<0.0001).

Both cohorts had comparable age, BMI, sex ratio, as well as surgical history and comorbidities (Table I). However, patients who received the KneeTec DeepDishTM were more sedentary, with lower Devane scores (p= 0.004). The main indication in both groups was primary osteoarthritis (93,8% of Triathlon® PS patients and 94,3% of KneeTec DeepDishTM patients; p= n.s.). Overall, the majority of patients were women (68.3%), aged over 70 years old, active, but with grade 1 obesity (BMI≥ 31) and an ASA score of 2.

Preoperative radiographic evaluation revealed that both cohorts had similar incidences of tibio-femoral (p= 0.066) and patella-femoral (p= 0.825) arthritis (Table II). Average frontal alignment was also equivalent in both cohorts, with median HKA angles of 175.3° (IQR, 172.2°-182.2°) in the Triathlon® PS cohort (varus : 46 patients (57,5%); valgus 22 patients (27,5%)), and 175.7° (IQR, 170.0°-182.0°) in the KneeTec DeepDishTM cohort (varus : 71 patients (70%) ; valgus : 15 patients (23,6%))(p=0.401). The median posterior tibial slope was 5° (IQR, 2.5°-7.0°) in the Triathlon® PS cohort and 4.4° (IQR, 2.1°-7.0°) for the KneeTec DeepDishTM cohort (p=0.711). Finally, the pre-operative patellar position was comparable on both cohorts, although fewer subluxations were noted in the Triathlon® PS cohort (4 knees, 5.0%) than in the KneeTec DeepDishTM cohort (11 knees, 10.4%).

For patients who received the KneeTec Deep DishTM implant, the IKS score was improved by 62.2 points (38 points on the knee subscale and 24.5 points on the function subscale) (all p<0.001) (Table III). The OKS was improved by 14 points (p<0.001). At follow-up, there were no statistically significant differences between the cohorts in terms of either score. The Likert Satisfaction Scale questionnaires indicated that a majority of patients were either satisfied or very satisfied with the intervention at follow-up (Triathlon® PS, 93.8%; KneeTec DeepDishTM, 94.4%).

Preoperatively, ROM was greater in the Triathlon® PS cohort than in the KneeTec DeepDishTM cohort, with a larger mobility arc (105° vs 100° p = 0.0218), a lower extension deficit (μ = -2,63° vs μ = -4.48°; p = 0,0423), and a greater flexion angle (110° vs 100°; p = 0,0731) (Table III). For patients who received the KneeTec DeepDishTM the net flexion gain was 14.2° (p<0.001), with a median angle of flexion at follow-up of 120° (Figure 2). Moreover, the patients' arc of mobility was increased by 17.9° (p<0.001). For patients who received the Triathlon® PS, the net flexion gain was 10.8° (p<0.001), with a median angle of flexion at follow-up of 120°. At follow-up, 97.5% of patients had angles of flexion of more than 100°. The patients' arc of mobility was increased by 12.8° (p<0.001). ROM was comparable between the cohorts at follow-up, with no statistically significant differences in flexion and extension angles, or overall arc of motion.

However, 34% of patients who had received the KneeTec DeepDishTM had a flexion angle over 130°, compared with 22.5% of patients who had received the Triathlon® PS (p=0,0827) (Figure 3).

For patients who received the KneeTec Deep DishTM, frontal knee laxity at follow-up was measured below 5° for 90.5% of patients, and anteroposterior knee laxity was measured below 5 mm for 97.2% of patients (Table 3). For patients who received the Triathlon® PS frontal knee laxity was measured below 5° for 83.8% of patients, and anteroposterior knee laxity was measured below 5 mm for 100% of patients. The was no statistically significant difference in laxity between the cohorts.

Follow-up radiographic analyses of radiolucent lines according to Ewald revealed no significant differences between the cohorts for either tibia (Anteroposterior p=0,8070; Lateral p=0,7602) or femur (p=0,5634) (Table IV). These radiolucent lines concerned 17 patients (21.3%) in the Triathlon® PS cohort, compared with 20 patients (18.9%) in the KneeTec DeepDishTM cohort. There were no traces of radiolucency at the level of the femoro-patellar joint. There were no differences in knee alignment or femoral notching.

Table I. — Patient demographics (N=186)

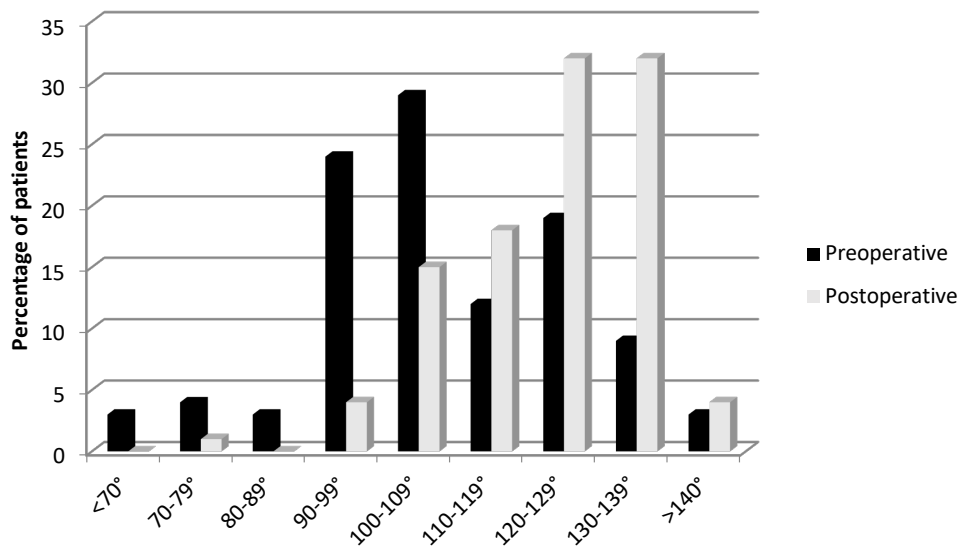| | | Triathlon® (N=80) | | | KneeTec™ (N=106) | | |
|---|---|---|---|---|---|---|---|
| | n | (%) / median | (IQR) | n | (%) / median | (IQR) | p-value |
| | | | | | | | 0.404 |
| Sex | | | | | | | |
|   Men | 28 | (35.0) | | 31 | (29.2) | | |
|   Women | 52 | (65.0) | | 75 | (70.8) | | |
| BMI (kg/m²) | 80 | 29.6 | (26.6-33.7) | 106 | 29.95 | (26.8-34.9) | 0.744 |
| Age (years) | 80 | 69 | (63-76) | 106 | 69 | (64-76) | 0.431 |
| Devane Score | | | | | | | **0.004** |
|   Sedentary | 2 | (2.5) | | 5 | (4.7) | | |
|   Semi sedentary | 19 | (23.8) | | 45 | (42.5) | | |
|   Leisure activity | 57 | (71.2) | | 47 | (44.3) | | |
|   Moderate activity | 2 | (5.5) | | 7 | (6.6) | | |
|   Professional athlete | 0 | (0.0) | | 2 | (1.9) | | |
| ASA Score | | | | | | | 0.490 |
|   ASA 1 | 10 | (12.5) | | 10 | (9.4) | | |
|   ASA 2 | 62 | (77.5) | | 78 | (73.6) | | |
|   ASA 3 | 8 | (10.0) | | 17 | (16.0) | | |
|   ASA 4 | 0 | (0.0) | | 1 | (0.9) | | |
| Abbr: BMI: Body-Mass Index | | | | | | | |



***Figure 2.*** — Range of pre- and post-operative flexion ranges for patients who received the CORIN KneeTec DeepDishTM.

Table II. — Preoperative patient knee characteristics

| | Triathlon® (N=80) | | | KneeTec™ (N=106) | | |
|---|---|---|---|---|---|---|
| | n | (%) | n | | (%) | p-value |
| Genu Flexum | | | | | | 0.091 |
| No | 55 | (68.7) | 60 | | (56.6) | |
| Yes | 25 | (31.3) | 46 | | (43.4) | |
| HKA angle (°) | | | | | | 0.118 |
| <170 | 10 | (12.5) | 23 | | (21.7) | |
| [170-178[ | 36 | (45.0) | 48 | | (45.3) | |
| [178-182] | 12 | (15.0) | 10 | | (9.4) | |
| ]182-190] | 15 | (18.7) | 15 | | (14.2) | |
| >190 | 7 | (8.8) | 10 | | (9.4) | |
| Patellar position | | | | | | 0.302 |
| Centered | 72 | (90.0) | 90 | | (84.9) | |
| Tilted | 4 | (5.0) | 3 | | (2.8) | |
| Subluxated | 4 | (5.0) | 11 | | (10.4) | |
| Dislocated | 0 | (0.0) | 2 | | (1.9) | |
| Tibiofemoral OA (Ahlbäck Classification) | | | | | | 0.066 |
| Stage 1 | 1 | (1.3) | 2 | | (1.9) | |
| Stage 2 | 28 | (35.0) | 31 | | (29.2) | |
| Stage 3 | 32 | (40.0) | 60 | | (56.6) | |
| Stage 4 | 19 | (23.8) | 13 | | (12.3) | |
| Patellofemoral OA (Iwano Classification) | | | | | | 0.825 |
| Stage 1 | 32 | (40.0) | 41 | | (38.7) | |
| Stage 2 | 29 | (36.3) | 40 | | (37.7) | |
| Stage 3 | 12 | (15.0) | 19 | | (17.9) | |
| Stage 4 | 7 | (8.8) | 6 | | (5.7) | |

Abbr: HKA: Hip-Knee-Ankle; OA: Osteoarthritis.

## DISCUSSION

The primary purpose of this study was to report the 12-month ROM, as well as clinical and radiographic outcomes of the CORIN KneeTec DeepDishTM. A secondary purpose was to compare these results to those of a comparable cohort who received the STRYKER Triathlon® PS. We report satisfactory 12-month ROM, clinical and radiographic outcomes of the KneeTec DeepDishTM, with no statistically significant differences when compared to 12-month outcomes of the Triathlon® PS. The original non-inferiority hypothesis is therefore demonstrated for a follow-up of 12 months. In the literature, UC implants are associated with successful short-term clinical and radiographic outcomes compared to PS implants (Table V), although there is more controversy regarding their success in terms of kinematics or stability *(8, 9)*. In our cohorts, patients had comparable 12-month ROM between KneeTec DeepDishTM and Triathlon® PS. Further, there were no differences in frontal or anteroposterior laxity at follow-up between the cohorts, suggesting the KneeTec DeepDishTM provides adequate

Table III. — Clinical outcomes

| | Triathlon® (N=80) | | | KneeTec™ (N=106) | | | |
|---|---|---|---|---|---|---|---|
| | N | median | IQR | N | median | IQR | p-value |
| **Knee Society Score (IKS)** | | | | | | | |
| Preoperative | | | | | 112.0 | (86-129) | |
| Postoperative | 80 | 170.0 | (157-189) | 106 | 172.5 | (145-92) | 0.580 |
| **IKS knee** | | | | | | | |
| Preoperative | | | | | 47.0 | (36-57) | |
| Postoperative | 80 | 89.0 | (80-98) | 106 | 91.5 | (77-97) | 0.662 |
| **IKS function** | | | | | | | |
| Preoperative | | | | | 60.0 | (45-75) | |
| Postoperative | 80 | 85.0 | (70-100) | 106 | 87.5 | (70-100) | 0.814 |
| **Oxford Knee Score (OKS)** | | | | | | | |
| Preoperative | | | | | 23.0 | (19-29) | |
| Postoperative | 80 | 40.0 | (35-42) | 106 | 40.0 | (33-43) | 0.880 |
| **Flexion (°)** | | | | | | | |
| Preoperative | 80 | 110 | (100-120) | 106 | 100 | (90-120) | 0.073 |
| Postoperative | 80 | 120 | (115-125) | 106 | 120 | (110-130) | 0.784 |
| **Extension (°)** | | | | | | | |
| Preoperative | 80 | 0 | (-5-0) | 106 | 0 | (-10-0) | 0.042 |
| Postoperative | 80 | 0 | (0-0) | 106 | 0 | (0-0) | 0.853 |
| **Mobility Arc (°)** | | | | | | | |
| Preoperative | 80 | 105 | (90-120) | 106 | 100 | (85-120) | 0.032 |
| Postoperative | 80 | 120 | (115-120) | 106 | 120 | (110-130) | 0.402 |
| **Frontal laxity (°)** | | | | | | | 0.197 |
| < 5 | 67 | 83.8 | | 96 | 90.5 | | |
| 5 – 9 | 13 | 16.2 | | 9 | 8.5 | | |
| 10–14 | 0 | 0.0 | | 1 | 0.9 | | |
| **Anteroposterior Laxity (mm)** | | | | | | | 0.510 |
| < 5 | 80 | 100.0 | | 103 | 97.2 | | |
| 5 – 9 | 0 | 0.0 | | 2 | 1.9 | | |
| ≥ 10 | 0 | 0.0 | | 1 | 0.9 | | |
| Abbr: IQR: Inter-Quartile Ran | | | | | | | |

Table IV. — Radiographic evaluation at follow-up

|  | Triathlon® (N=80) | KneeTec™(N=106) |  |
|---|---|---|---|
|  | n (%) | n (%) | p-value |
| Angle HKA (°) |  |  | 0.762 |
| <170 | 0 (0.0) | 1 (0.9) |  |
| [170-178[ | 18 (22.5) | 30 (28.3) |  |
| [178-182] | 44 (55.0) | 54 (50.9) |  |
| ]182-190] | 18 (22.5) | 20 (18.9) |  |
| >190 | 0 (0.0) | 1 (0.9) |  |
| Femoral notching | 4 (5.0) | 5 (4.7) | 0.701 |
| Radiolucent lines according to Ewald |  |  |  |
| Tibial anteroposterior |  |  | 0.807 |
| None | 71 | 91 |  |
| Zone 1-2 | 8 | 12 |  |
| Zone 3-4 | 1 | 3 |  |
| Zone 5 | 0 | 0 |  |
| Zone 6 | 0 | 0 |  |
| Zone 7 | 0 | 0 |  |
| Tibial lateral |  |  | 0.760 |
| None | 78 | 104 |  |
| Zone 1 | 1 | 0 |  |
| Zone 1' | 0 | 0 |  |
| Zone 2 | 1 | 2 |  |
| Zone 2' | 0 | 0 |  |
| Zone 3 | 0 | 0 |  |
| Femoral |  |  | 0.563 |
| None | 70 | 89 |  |
| Zone 1 | 8 | 14 |  |
| Zone 2 | 2 | 1 |  |
| Zone 3 | 0 | 0 |  |
| Zone 4 | 1 | 4 |  |
| Zone 5-7 | 0 | 0 |  |
| Patellar |  |  | 1 |
| Yes | 0 (0.0) | 0 (0.0) |  |
| No | 80 (100.0) | 33 (100.0) |  |

stability. Nevertheless, further studies are therefore necessary to investigate knee kinematics using the CORIN KneeTec DeepDishTM.

The PS design is well-known for its advantageous ROM. Despite equivalent clinical results to PS, several authors report inferior ROM with UC
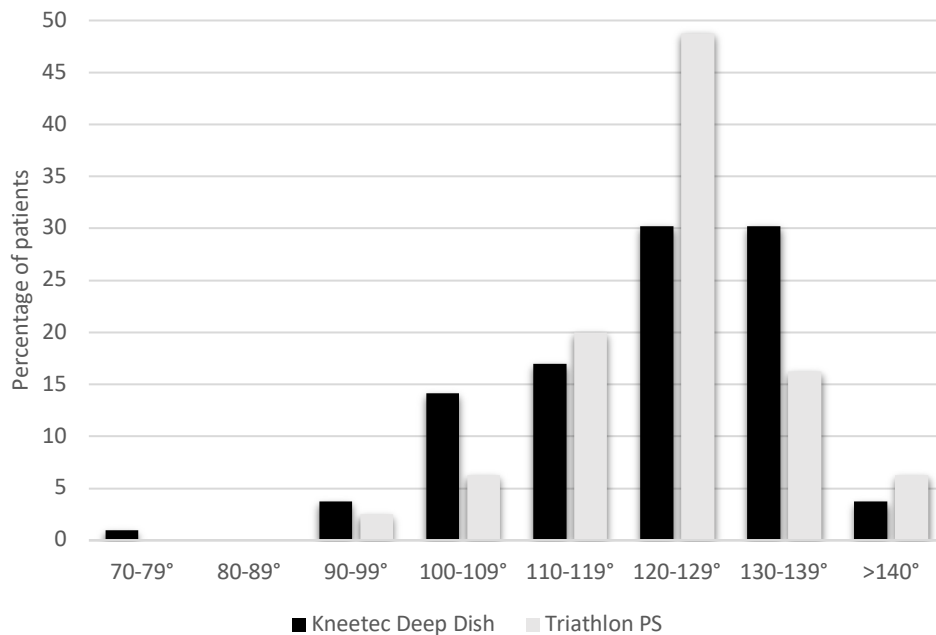
*Figure 3.* — Comparison of the postoperative flexion ranges of patients who received the CORIN
KneeTec DeepDishTM with those of patients who received the STRYKER Triathlon® PS.

implants *(8)*, while other find no difference *(19)*. In a meta-analysis, Bae et al. *(8)* report that UC implants in general have greater external femoral rotation and less posterior rotation than PS implants, which they argue may impact knee kinematics. Further, they found UC implants had greater anteroposterior tibial laxity and less ROM than PS implants. However, femoral rollback is not in itself correlated with superior clinical outcomes *(6)*. In the present study, there were no differences in ROM between the cohorts, with median flexion ranges of 120°. Furthermore, 95,3% of patients who received the KneeTec DeepDishTM implant had arc-of-motions of more than 100°, which allow the majority of daily activities *(20)*, and a third (34%) had arc-of-motions of over 130°, which is considered a normal range. Nevertheless, because only 22.5% of patient with the Triathlon® PS achieved arc-of-motions of over 130°, the KneeTec DeepDishTM may have an advantage over the former in terms of allowing deep flexion. A large cohort study with a similar UC implant *(21)* reported an average flexion of 115° at a follow-up of 5 years, suggesting the good ROM observed in the present study could be extended to longer follow-up.

However, further studies with longer follow-up are necessary to verify this hypothesis.

In the present study, there was operator-dependent difference between the cohorts. The KneeTec DeepDishTM cohort was operated on using the anteromedial parapatellar approach, while the Triathlon® PS was operated on using mainly the midvastus approach. Using different surgical approaches is not expected to have had an impact on outcomes in this study.

The follow-up of 12 months is sufficient to study short-term functional results of TKA. Indeed, several studies demonstrated the stability of these functional results from 1 year to 5 years after TKA. The rate of patients lost to follow-up of 24% may appear high. It can be explained by the old age of the patients and a relatively high rate of sedentary patients (38,2%).

The KneeTec DeepDishTM demonstrated excellent functional results, with 94.4% of patients satisfied or very satisfied. This satisfaction rate is notably higher than the 75% reported by Shan *(22)* in their study on satisfaction after TKA. UC design presents certain advantages that make it an important alternative for arthroplasty. Indeed, despite its

Table V. — Comparisons of the outcomes of UC implants with PS implants in the literature

| Author | Year | Journal | Implant | Follow-up (years) | Clinical outcomes | Radiographic outcomes | Stability and kinematics |
|---|---|---|---|---|---|---|---|
| Han | 2020 | KSSTA | Triathlon | 2 | AS (UC) worse | AS (UC) worse | - |
| Lee | 2019 | JOS | Columbus | 5 | same | same | same |
| Bae | 2018 | KSSTA | - | meta-analysis | same | UC worse | UC worse |
| Fritzsche | 2017 | KSSTA | Columbus | intraoperative | - | UC worse | UC worse |
| Lützner | 2017 | KSSTA | Columbus | 1 | KSS same, OKS UC better | same | UC different |
| Lützner | 2016 | KSSTA | Columbus | 1 | KSS same, OKS UC better | same | UC different |
| Singh | 2016 | JCOT | Natural Knee | 3 months | UC worse | - | UC worse |
| Kim | 2015 | KSSTA | E-motion | 3 | same | - | UC different |
| Machhindra | 2015 | JoA | E-motion | 2 | same | UC worse | - |
| Sur | 2015 | JoA | Triathlon (CS) | 5 | same | - | UC worse |
| Appy Fedida | 2015 | OTSR | Triathlon | | - | - | UC more laxity |
| Bignozzi | 2014 | KSSTA | Gemini | 2 | same | - | same |
| Argenson | 2013 | OTSR | mixed | 10 | same | same | - |
| Uvehammer | 2001 | JoA | AMK (CS) | 2 | same | same | same |
| Laskin | 2000 | CORR | Genesis II | 3 months | same | same | same |

Abbr: UC: Ultracongruent; PS: Posterior-Stabilized; KSSTA:Knee Surgery, Sports Traumatology, Arthroscopy; JOS: Journal of Orthopaedic Science; JCOT: Journal of Clinical Orthopaedics and Trauma; JoA: The Journal of Arthroplasty; OTSR: Orthopaedics & Traumatology: Surgery & Research; CORR: Clinical Orthopaedics and Related Research.

widespread use, PS TKA is susceptible to several issues including breakage or dislocation of the post-cam and the patellar clunk syndrome *(9)*. In contrast, UC designs preserve bone stocks, which is important due to the rise of younger, more obese patients *(23)*. Further, UC implants require shorter surgical time and allow faster patient recovery *(24)*.

To the authors' knowledge, this is the first study reporting short-term outcomes of the CORIN KneeTec DeepDishTM. Due to the presence of a comparable cohort in the same center who received the STRYKER Triathlon® PS, we were able to compare these outcomes with those of this gold-standard of PS TKA. Despite minor peri-operative differences, both cohorts were remarkably similar in terms of demographics, which lends weight to the comparison. However, this study has limitations. The large number of patients excluded in the KneeTec DeepDishTM cohort due to loss to follow-up compared to that of the Triathlon® PS cohort (25.3% vs 12.8%) may have caused us to overestimate outcomes. Moreover, the comparison between the implants is imperfect due to different operative approaches and average follow-up time.

## CONCLUSION

This study is the first to report the 12-month outcomes of the CORIN KneeTec DeepDishTM. In our practice, the KneeTec DeepDishTM demonstrated equivalent radiographic and clinical outcomes to those obtained with the Triathlon®

PS. Moreover, there were no differences at follow-up in terms of knee laxity or ROM between the two implants. Patient satisfaction in the KneeTec DeepDishTM reached 94.4%. Further studies will be necessary to evaluate the mid- to long-term outcomes and survival of the KneeTec DeepDishTM.

## REFERENCES

1. Sculco TP. The role of constraint in total knee arthoplasty. J Arthroplasty 2006; 21:54-6.
2. Baumann F. Bicruciate-retaining total knee arthroplasty compared to cruciate-sacrificing TKA: what are the advantages and disadvantages? Expert Rev Med Devices 2018; 15 : 615-7.
3. Jiang C, Liu Z, Wang Y, Bian Y, Feng B, Weng X. Posterior Cruciate Ligament Retention versus Posterior Stabilization for Total Knee Arthroplasty: A Meta-Analysis. PLoS One 2016; 11: e0147865.
4. Hofmann AA. A double deep-dish geometry. Orthopedics 2002; 25 : 961.
5. Lee SS, Yeom J, Lee DH, Moon YW. Similar outcomes between ultracongruent and posterior-stabilized insert in total knee arthroplasty: A propensity score-matched analysis. J Orthop Surg (Hong Kong) 2020; 28: 2309499019893515.
6. Meneghini RM, Stefl MD, Hodge WA, Banks SA. A Cam-Post Mechanism Is No Longer Necessary in Modern Primary Total Knee Arthroplasty. J Knee Surg 2019; 32: 710-3.
7. Massin P, Boyer P, Sabourin M. Less femorotibial rotation and AP translation in deep-dished total knee arthroplasty. An intraoperative kinematic study using navigation. Knee Surg Sports Traumatol Arthrosc 2012; 20: 1714-9.
8. Bae JH, Yoon JR, Sung JH, Shin YS. Posterior-stabilized inserts are preferable to cruciate-substituting ultracongruent inserts due to more favourable kinematics and stability. Knee Surg Sports Traumatol Arthrosc 2018; 26: 3300-10.
9. Fritzsche H, Beyer F, Postler A, Lützner J. Different intraoperative kinematics, stability, and range of motion between cruciate-substituting ultracongruent and posterior-stabilized total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2018; 26: 1465-70.
10. Hamai S, Miura H, Higaki H, Shimoto T, Nakanishi Y, Iwamoto Y. Kinematic analysis of mobile-bearing total knee arthroplasty using a 6-DOF knee simulator. J Orthop Sci 2008; 13:543-9.
11. Gaillard R, Lustig S, Peltier A, Villa V, Servien E, Neyret P. Total knee implant posterior stabilised by a third condyle : Design evolution and post-operative complications. Orthop Traumatol Surg Res 2016; 102: 1061-8.
12. Van der Bracht H, Van Maele G, Verdonk P, Almqvist KF, Verdonk R, Freeman M. Is there any superiority in the clinical outcome of mobile-bearing knee prosthesis designs compared to fixed-bearing total knee prosthesis designs in the treatment of osteoarthritis of the knee joint? A review of the literature. Knee Surg Sports Traumatol Arthrosc 2010; 18:367-74.
13. Scott CE, Clement ND, MacDonald DJ, et al. Five-year survivorship and patient-reported outcome of the Triathlon single-radius total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2015; 23: 1676-83.
14. Devane PA, Horne JG, Martin K, Coldham G, Krause B. Three-dimensional polyethylene wear of a press-fit titanium prosthesis. Factors influencing generation of polyethylene debris. J Arthroplasty 1997; 12: 256-66.
15. Dawson J, Fitzpatrick R, Murray D, Carr A. Questionnaire on the perceptions of patients about total knee replacement. J Bone Joint Surg Br 1998; 80: 63-9.
16. Ahlbäck S. Osteoarthrosis of the knee. A radiographic investigation. Acta Radiol Diagn (Stockh) 1968; 277: 7-72.
17. Iwano T, Kurosawa H, Tokuyama H, Hoshikawa Y. Roentgenographic and clinical findings of patellofemoral osteoarthrosis. With special reference to its relationship to femorotibial osteoarthrosis and etiologic factors. Clin Orthop Relat Res 1990;252: 190-7.
18. Ewald FC. The Knee Society total knee arthroplasty roentgenographic evaluation and scoring system. Clin Orthop Relat Res 1989; 248 : 9-12.
19. Song EK, Lim HA, Joo SD, Kim SK, Lee KB, Seon JK. Total knee arthroplasty using ultra-congruent inserts can provide similar stability and function compared with cruciate-retaining total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2017; 25: 3530-5.
20. Huddleston J, Alaiti A, Goldvasser D, et al. Ambulatory measurement of knee motion and physical activity: preliminary evaluation of a smart activity monitor. J Neuroeng Rehabil 2006;13 ; 3:21.
21. Châtain F, Gaillard TH, Denjean S, Tayot O. Outcomes of 447 SCORE® highly congruent mobile-bearing total knee arthroplasties after 5-10 years follow-up. Orthop Traumatol Surg Res 2013 ; 99 : 681-6.
22. Shan L, Shan B, Suzuki A, Nouh F, Saxena A. Intermediate and long-term quality of life after total knee replacement: a systematic review and meta-analysis. J Bone Joint Surg Am 2015; 97: 156-68.
23. Mohamed NS, Wilkie WA, Remily EA, et al. The Rise of Obesity among Total Knee Arthroplasty Patients. J Knee Surg 2020 22 ; 35: 1-6
24. Machhindra MV, Kang JY, Kang YG, Chowdhry M, Kim TK. Functional Outcomes of a New Mobile-Bearing Ultra-Congruent TKA System: Comparison with the Posterior Stabilized System. J Arthroplasty 2015 ; 30: 2137-42.