



GEMINI SL Total Knee System



Literature Research

CE 0482

Explanation of Pictograms			
	Manufacturer		Article number
	Material number		Product meets the applicable requirements, which are regulated in the EU harmonization legislation for the affixing of the CE marking.

GEMINI SL Total Knee System

Literature Research

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Primary Total Knee Arthroplasty GEMINI SL

Overview

The **GEMINI SL Total Knee Replacement** is a modular knee prosthesis system.

GEMINI SL Total Knee Replacement system accounts for greater versatility.

The GEMINI SL Knee System allows for native joint reconstruction with an extensive range of motion and good kinematics (12). Primary stability is guaranteed through accurate fit of the femoral and tibial components, and due to proper choice from an extensive selection of sizes (1,12). Three configurations (Fixed Bearing CR, Fixed Bearing PS and Mobile Bearing) and optional tibial stem extensions expand the range of indications and enable comprehensive treatment options.

The Knee System consists of femoral components, articular surfaces and tibial components. It comes in different sizes for femur and tibia and different heights for the articular surfaces. There are eight sizes left and eight sized right for femoral replacement and five sizes each left and right for the tibial replacement. There are four heights for the articular surface Mobile Bearing and five heights for the articular surface Fixed Bearing. The tibial component is available in monobloc or modular. The modular version has a taper connection allowing for assembly of various tibial stem extensions. For Femur and Tibia components there is a version for cemented application and a version for cementless application available. Additionally hybrid application is possible as well. For cementless application there is a double coating TiCaP applied.

All versions are offered with LINK PorEx (TiNbN) surface modification, which allow application for metal sensitive patients.



GEMINI SL Configurations

Cruciate Retaining Fixed Bearing (CR)	Posterior Stabilized Fixed Bearing (PS)	Mobile Bearing
		
Cruciate Retaining configuration for use with intact ligaments and capsule and adequate joint stability. Identical tibial metal tray for Fixed Bearing CR and PS.	Posterior Stabilized configuration for use with absence of posterior cruciate ligament. Reduces the risk of dislocation and decreases contact pressure in deep flexion (21). Featuring bone preserving design with size specific intercondylar femoral box dimensions.	Rotating highly congruent articular surface for use with or without posterior cruciate ligament.

Heritage

The **T.A.C.K.** (Total Articulating Cementless Knee) was the precursor of the GEMINI SL Total Knee System offered by LINK. It was available cementless and cemented consisting of a femoral component which was highly congruent and anatomically shaped, with left and right versions. The nonarticulating surfaces of tibia and femur are textured to encourage bone ingrowth, with or without hydroxyapatite coating. A version to be cemented was also available. The tibial part has two components. A metal tray with a conical stem is implanted on the bone, and a high-conforming ultrahigh-molecular-weight polyethylene bearing (UHMWPE) sits in the tray.

GEMINI was designed to extend the product portfolio for Total Knee Arthroplasty as Fixed Bearing CR and PS. GEMINI consists of an anatomically shaped femoral component in five sizes and respectively five sizes of anatomically shaped tibial components which can be extended with tibial stems. Finally there were articulating surfaces in different heights in the corresponding five sizes.

GEMINI MKII was then an additional portfolio extension with Mobile Bearing configuration which was marketed as GEMINI MKII. The fixation concept for Mobile Bearing of the articular surface on the tibia was maintained from T.A.C.K., design of femoral and tibial component was maintained from GEMINI.

Purpose of the Research

The purpose of this literature research is to show different papers of the GEMINI SL Total Knee System. There are three groups of publications. First there are papers about clinical outcome. Here the focus is on the Hospital for Special Surgery Score (HSS), Knee Society Score (KSS), the survival rate and the range of motion (ROM). Second there are papers considering biomechanical results and finally there is data of registry considered survival outcome.

Definitions

Knee Society Clinical Rating System

The Knee Society Clinical rating System is subdivided into a Knee Score and a Functional Score. The Knee Society Score differentiates between knee rating and functional assessment. (1)

Knee Society Score (KSS)

With regard to the knee assessment, it was decided that only the three main parameters of pain, stability, and range of motion should be judged and that flexion contracture, extension lag, and misalignment should be dealt with as deductions. Thus, 100 points will be obtained by a well-aligned knee with no pain, 125° of motion, and negligible anteroposterior and mediolateral instability.

The Knee Society Score rates the Pain, the range of Motion and the stability of the knee. It's possible to award 100 points or different classes. Maximal 50 points for pain, 25 for range of motion and 25 for stability.

Knee Functional Score (KFS)

Patient function considers only walking distance and stair climbing, with deductions for walking aids. The maximum function score, which is also 100, is obtained by a patient who can walk an unlimited distance and go up and down stairs normally. The walking ability is expressed in blocks (100 meters). The stair climbing is considered if the patient can ascend and descend without holding the railing

Hospital for Special Surgery-Score (HSS)

The Hospital for Special Surgery Knee Score was introduced in the late 1970s. As physicians and investigators at the Hospital for Special Surgery reported their results with different types of prosthesis, they modified their rating scales until they finally agreed to the data collected by the HSS Knee Score. The HSS Knee Score is based on a total of 100 points. The score is divided into seven categories, which include pain, function, range of motion, muscle strength, flexion deformity, instability, and subtractions.

The knee is initially given a score of 0, and additions or subtractions are made according to specific criteria. The higher the score, the better the outcome. Approximately 50% of the score is based on a patient interview and the remaining on physical exam. (2)

Evaluation of HSS-Score

Table 1: Evaluation of HSS-Score (2)

Score	
90-100	Excellent
80-89	Good
70-79	Fair
Below 70	Poor

Western Ontario an McMaster Osteoarthritis Index (WOMAC)

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is a widely used measure of symptoms and physical disability originally developed for people with osteoarthritis (OA) of the hip and/or knee. (3) The WOMAC evaluates 3 dimensions: pain, stiffness, and physical function with 5, 2, and 17 questions, respectively. The Likert version of the WOMAC is rated on an ordinal scale of 0 to 4, with lower scores indicating lower levels of symptoms or physical disability. Each subscale is summated to a maximum score of 20, 8, and 68, respectively.

There is also an index score or global score, which is most commonly calculated by summing the scores for the 3 subscales. A visual analog scale (VAS) version of the WOMAC is also available. The WOMAC score is for knee and/or hip. The WOMAC evaluate the pain, stiffness and function of patients with osteoarthritis. The score is focused just on the long-term consequences. The WOMAC is used for knee OA, chondral defects and anterior cruciate ligament deficiency. A higher score indicate worse pain, stiffness or physical function.

Range of Motion (ROM)

The Range of Motion is routinely used to judge injuries and diseases in the locomotor system. With ROM angel of flexion are measured, extension and hyperextension before and after TKA. (4)

Overview Tables

Overview of all Clinical Studies

Study	Year of Publication	No of Patients	Mean Follow-up (range)	Mean Age (Range)	Reason for TKA	GEMINI SL MB PCL Preserving	GEMINI SL MB PCL Sacrificing	GEMINI SL FB CR	GEMINI SL FB PS	Clinical Parameter
Kong	2023	143	3 yrs	66.7	Osteoarthritis	X				ROM KSS function FJS
Liu	2021	42	12 months	62.1 (±4.6)	Primary knee osteoarthritis	X				HSS WOMAC
Ma	2019	109	5 yrs	73.2 (67-83)	Primary knee Degenerative OA	X				ROM KSS clinical KSS function
Song	2017	22	n.a.	63.95 yrs ± 2.0	Primary knee osteoarthritis	X				HSS Patella score
Zhang	2016	92	2 yrs	67.8 (59-76)	Primary knee OA	X				ROM KSS clinical KSS function
Yang	2015	187	2 yrs	64.8 ± 5.3	Bilateral knee OA	X				SF-36 VAS ROM
Bignozzi	2014	30	2 yrs	69 yrs (57-83)	Primary knee OA	X	X			WOMAC KSS SF36
Zhou	2014	32	10 yrs (8-11)	57 yrs (47-63)	Primary severe valgus knee deformity RA OA	X				ROM HSS Survival rate
Zha	2014	139	1.5 yrs	68.5 (51-85)	Primary degenerative OA	X				KSS clinical KSS function VAS
Vahtrik	2014	14	6 months	60.2 yrs (46-68)	Degenerative knee OA	X				Pain (VAS) ROM
Zeng	2014	29	6 months	65.07 yrs ± 9.16 (45-79)	Osteoarthritis Rheumatoid arthritis				X	Pain (VAS)
Sarap	2014	50	5 yrs	n.a.	Primary osteoarthritis Secondary osteoarthritis Rheumatoid arthritis	X				VAS AKS
Thabe	2013	442	11,2	27-92 yrs	OA Rheumatoid arthritis	X				HSS ROM Survival rate
Chen	2012	28	9.8 months (6-18)	66.3 (61-73)	Primary knee osteoarthritis Rheumatoid arthritis				X	ROM HSS Pain
Wang	2012	20	12 months	n.a. 61-70	Varus deformity Valgus deformity Flexion deformity	X				HSS Patella score
Gapeyeva	2011	8	6 months	66 yrs (58-77)	Primary degenerative knee OA	X				AROM WOMAC
Rätsepsoo	2011	14	6 months	60.2 ± 2.0	Primary knee OA	X				VAS
Gapeyeva	2007	10	6 months	63 yrs (52-74)	Degenerative knee OA	X				KSS clinical KSS function VAS

NOTE: Hyperlinks to the summary of the studies available in PDF version

Overview of all Biomechanical Studies

Study	Year of Publication	GEMINI SL MB PCL Preserving	GEMINI SL MB PCL Sacrificing	GEMINI SL FB CR	GEMINI SL FiB PS
Innocenti	2019		X	X	
Innocenti	2019	X		X	X
Innocenti	2019				X

NOTE: Hyperlinks to the summary of the studies available in PDF version

Overview Registry Data Survival Rate

Registry	Year of Publication	No of Patients	GEMINI SL FB CR	GEMINI SL FB PS	GEMINI SL MB	Survival rate (%) after 2 yrs	Survival rate (%) after 5 yrs	Survival rate (%) after 6 yrs	Survival rate (%) after 10 yrs
EPRD	2024	416	X					91.5	
EPRD	2024	768		X				92.8	
SIRIS	2023	128		X		99.2			
R.I.P.O.	2023	2683			X		96.2		94.7

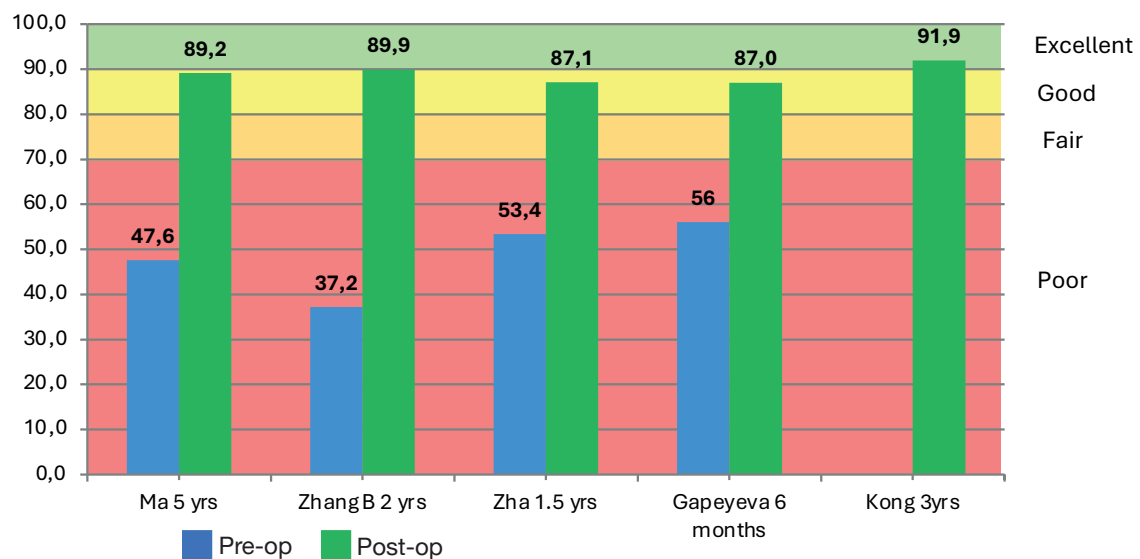
NOTE: Hyperlinks to the summary of the studies available in PDF version

Overview of KSS and KFS

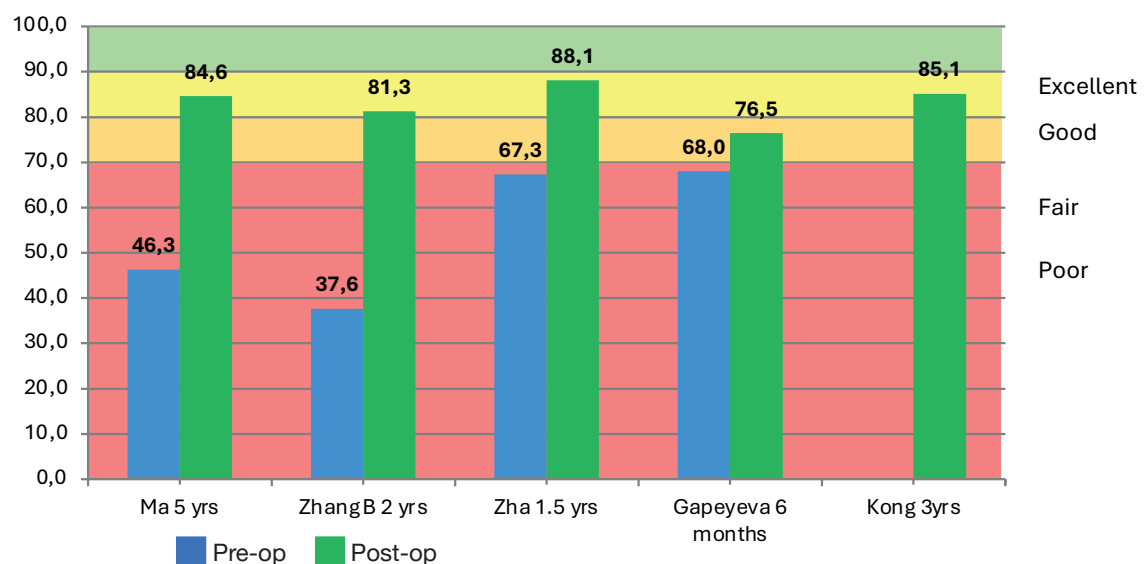
Study	KSS Pre-op (range)	KSS Post-op (range)	KFS Pre-op (range)	KFS Post-op (range)
Ma	47.6 points (± 9.5)	89.2 points (± 3.6)	46.3 points (± 11.9)	84.6 points (± 9.8)
Zhang B	37.2 points (± 4.0)	89.9 points (± 2.6)	37.6 points (± 4.1)	81.3 points (± 1.9)
Zha	53.4 points (± 16.1)	87.1 points (± 9.0)	67.3 points (± 7.3)	88.1 points (± 9.0)
Gapeyeva	56.0 points (20-68)	87.0 points (62-93)	68.0 points (35-80)	76.5 points (47-100)
Kong	–	91.9 points	–	85.1 points

NOTE: Hyperlinks to the summary of the studies available in PDF version

KSS

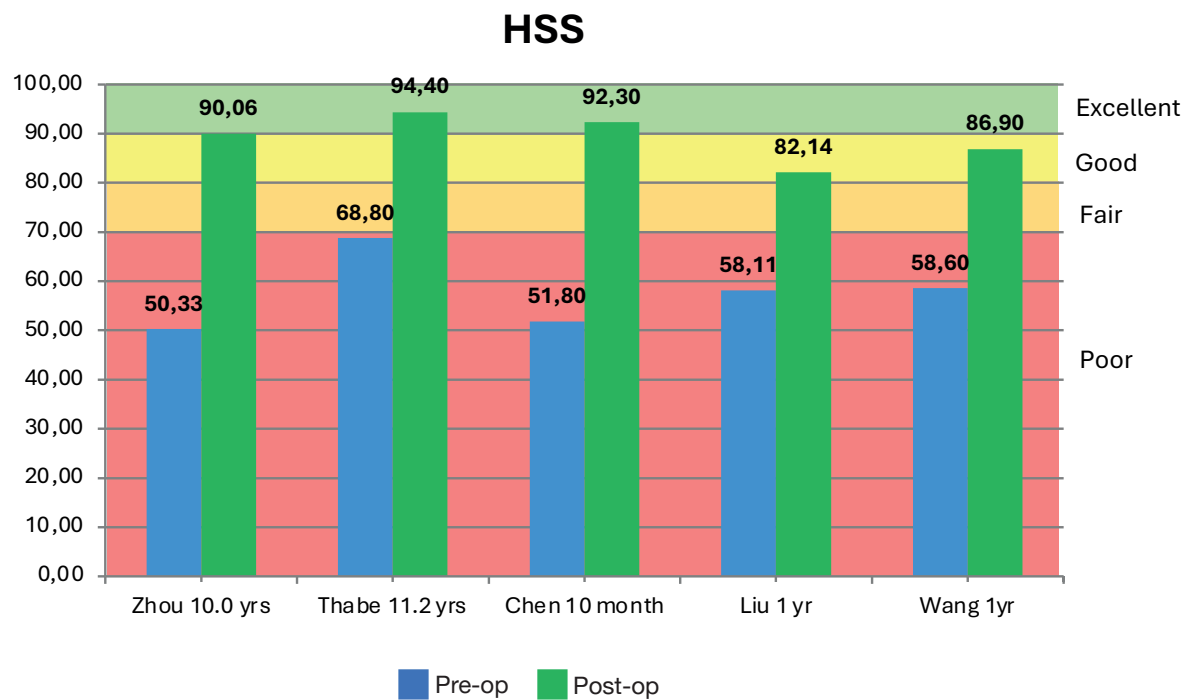


KFS



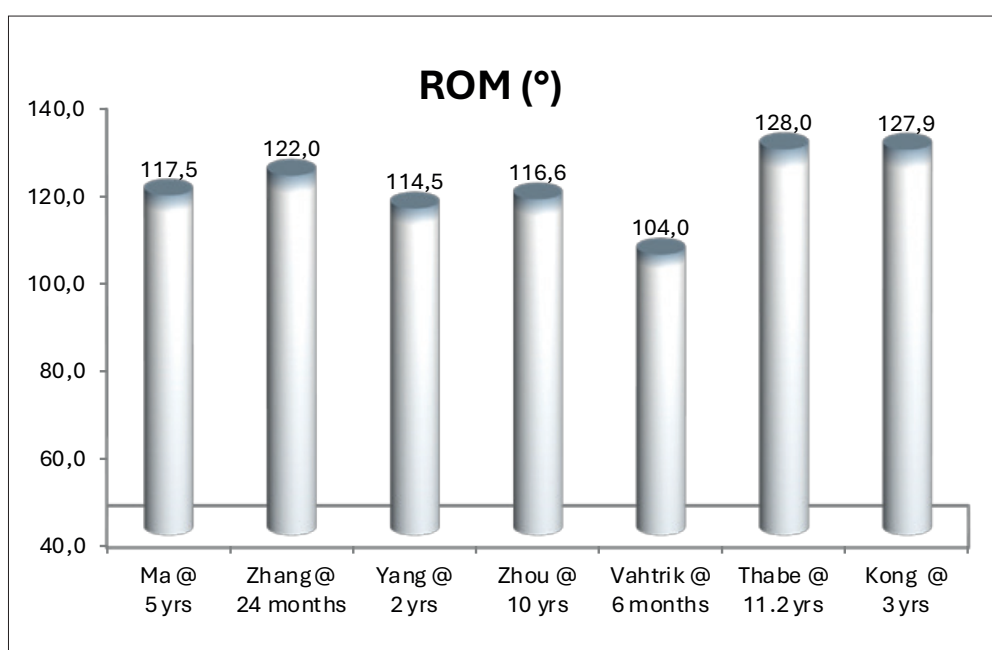
Overview of HSS

Study	Time	Pre-op	Post-op
Zhou	10 yrs	50.33 Points	90.06 Points
Thabe	11.2 yrs	68.8 Points	94.4 Points
Chen	9.8 months	51.80 Points	92.30 Points
Liu	1 yr	58.11 Points	82.14 Points
Wang	1 yr	58.60 Points	86.90 Pointsx



Overview of ROM

Study	ROM Pre-op	ROM Post-op
Ma 5 yrs	103.2°	117.5°
Zhang 24 months	99.4°	122.0°
Yang 2 yrs	88.2°	114.5°
Zhou 10 yrs	93.72°	116.6°
Vahtrik 6 months		104.0°
Thabe 11.2 yrs		128°
Kong		127.9

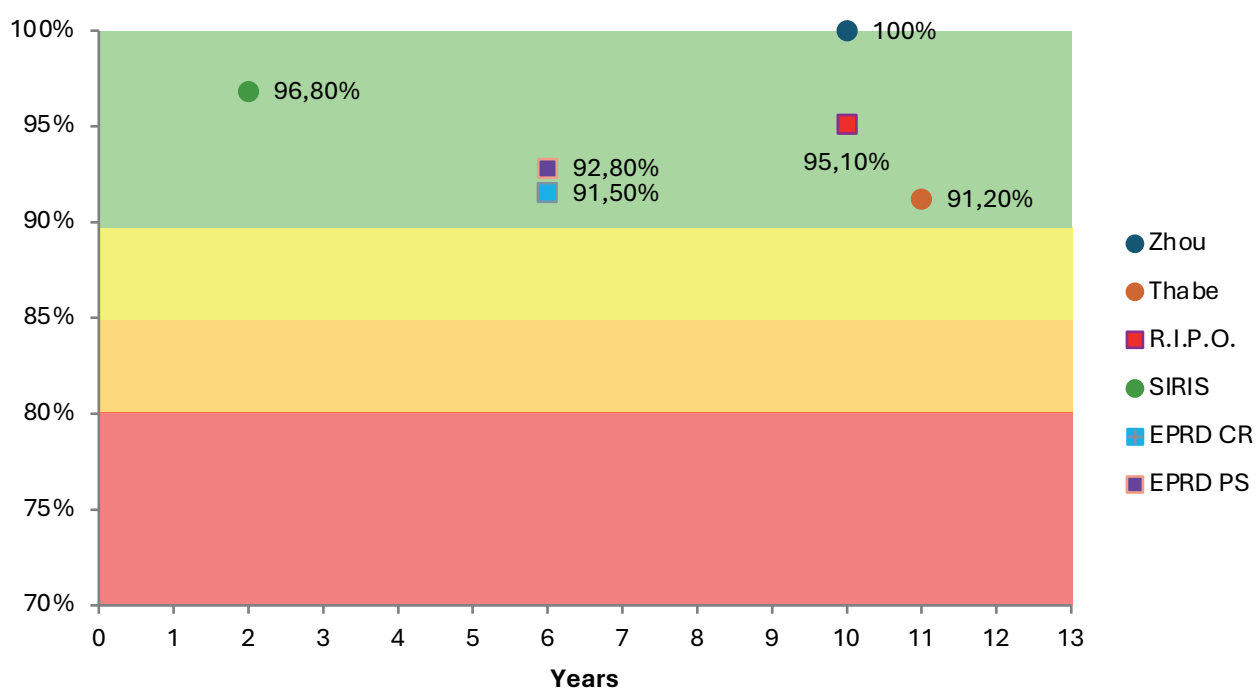


Overview Survival Rate

Study / Registry	2 yrs	6 yrs	6.3 yrs	10 yrs	11.2 yrs
Zhou				100%	
Thabe					91.2%
R.I.P.O.				95.1%	
SIRIS	96.5%				
EPRD CR		91.5%			
EPRD PS		92.8%			

NOTE: Hyperlinks to the summary of the studies available in PDF version

Survival Rate



ODEP Rating

ODEP, the Orthopaedic Data Evaluation Panel was set up in 2002 to implement NICE guidance on primary hip implants. Hip resurfacing followed in 2004. Since 2014 Knees have been added to the list of joints that ODEP benchmark and early in 2017 ODEP commenced benchmarking Shoulders [<http://www.odep.org.uk>]



The **Mobile Bearing** configuration of the **GEMINI SL** received this high quality rating for a knee implant awarded by the United Kingdom's Orthopaedic Data Evaluation Panel.

A **rating of 10A** is given to implants that have demonstrated at least **93% survival at 10 years** based on data meeting **ODEP's criteria** for the strongest data quality.

A **rating of 3A** is given to implants that have demonstrated at least **94.5% survival at 3 years** based on data meeting **ODEP's criteria** for the strongest data quality.

10A: A minimum cohort of 500 knees at the start of the study with a minimum of ten years followup and an actual revision rate of less than 7%. All deaths, loss to follow-up, failures and indications for revisions are recorded. Minimum at risk at benchmark time: 51.

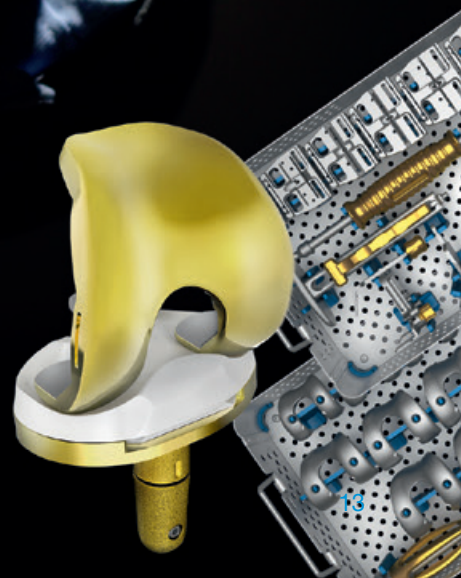
3A: A minimum cohort of 150 knees at the start of the study with a minimum of ten years follow up and an actual revision rate of less than 5.5%. All deaths, loss to follow-up, failures and indications for revisions are recorded. Minimum at risk at benchmark time: 66.

What if you had a golden key?



GEMINI SL PorEx
with SPAR-K Instruments

Efficient Precise Reliable



Literature Abstracts

Here is a list of different papers and their abstracts related to GEMINI SL Total Knee System. These papers include information about the survival rate, about mid-term and long-term follow-ups evaluated by HSS scores, results of functional and clinical score KSS and outcome of biomechanical studies.

Intact, pie-crusting and repairing the posterior cruciate ligament in posterior cruciate ligament-retaining total knee arthroplasty: A 5-year follow-up.

De-Si Ma, Liang Wen, Zhi-Wei Wang, Bo Zhang, Shi-Xiang Ren, Yuan Lin
World J Clin Cases 2019 December 26; 7(24): 4208-4217

Purpose

The posterior cruciate ligament (PCL) is important for cruciate-retaining (CR) total knee arthroplasty (TKA). Whether the entire PCL should be retained during CR-TKA is controversial. The aim of this study is to evaluate the clinical outcomes of PCL preservation in CR-TKA and the methods used to deal with the PCL during surgery.

Methods

A retrospective review of patients with osteoarthritis undergoing primary CR-TKA (176 patients, 205 knees) in our institution between March 2012 and March 2014 was performed. A PCL protector was used to preserve the intact PCL bone block. The status of the PCL was recorded during surgery. Intact PCL preserved, pie-crusting and repairing were used to balance the tension of the PCL. Range of motion (ROM) and the Knee Society Clinical Rating System (KSS) were evaluated preoperatively and at the endpoint of follow-up.

Results

The mean ROM of the knee was $103.2 \pm 17.2^\circ$, KSS clinical score was 47.6 ± 9.5 and KSS functional score was 46.3 ± 11.9 before surgery. The mean ROM of the knee was $117.5 \pm 9.7^\circ$, KSS clinical score was 89.2 ± 3.6 and KSS functional score was 84.6 ± 9.8 at 5 years follow-up. ROM, KSS clinical scores and KSS functional scores were significantly improved after surgery ($P < 0.01$). Thirty-two (23.7%) TKAs involved PCL pie-crusting and 18 (13.3%) involved PCL repair. Eighty-five (63.0%) TKAs applied standard operating procedures and preserved intact PCL. At 5 years follow-up, in the intact PCL group, the mean ROM of the knee was $118.0 \pm 8.3^\circ$, KSS clinical score was 89.1 ± 3.7 and KSS functional score was 84.9 ± 9.6 . In the PCL pie-crusting group, mean ROM of the knee was $114.0 \pm 13.5^\circ$, KSS clinical score was 88.8 ± 3.4 and KSS functional score was 83.8 ± 10.5 . In the PCL repair group, mean ROM of the knee was $120.3 \pm 7.0^\circ$, KSS clinical score was 89.0 ± 3.6 and KSS functional score was 89.4 ± 4.5 . There were no significant differences in ROM, KSS clinical scores and KSS functional scores among the three groups ($P > 0.05$).

	5 yrs Post-op
KSS Clinical Scores	89.2 ± 3.6
KSS Functional Scores	84.6 ± 9.8
Range of Motion	$117.5^\circ \pm 9.7^\circ$

[Overview of all Clinical Studies...](#)

Literature Abstracts

The effect of femoral prosthesis design on patellofemoral contact stresses in total knee arthroplasty: a case-control study with mid-term follow-up minimum 3-year follow-up.

Lingce Kong, Wei Lin, Huijun Kang, Ming Li, Kuo Hao. Journal of Orthopaedic Surgery and Research (2023) 18:781

Background To investigate the differences in postoperative patellofemoral pressures and patellar tracking during at least three years of follow-up in patients using three prostheses of different designs in total knee arthroplasty (TKA) without patellar resurfacing.

Methods

Radiographic investigations The study included 401 patients who had a total of 480 knee prostheses implanted without patellar resurfacing. The prostheses used were Genesis II (external rotation design of femoral prosthesis), Triathlon (design with deep trochlear grooves), and Gemini MK II (deepening of trochlear groove and lateral condylar protrusion that closely follows the anatomical shape). The patients' patellar tracking was assessed by measuring patellar tilt and displacement during postoperative follow-up. Furthermore, postoperative knee function and pain were evaluated through range of motion, Knee Society Scores (KSS), and Forgotten Joint Score (FJS) to compare the different groups.

Finite element analysis Constructing a finite element model of the knee joint of a normal volunteer after total knee arthroplasty using different prostheses for nonpatellar replacement. The three models' von Mises stress distribution heat map, peak contact pressure, and patellar transverse displacement were compared at 30°, 60°, and 90°, respectively.

Results:

Radiographic investigations A total of 456 knees of 384 patients were investigated at a 3-year follow-up after TKA without patellar resurfacing. There were no significant differences in patellar tracking between the three groups. Patients with all three prostheses demonstrated favorable clinical outcomes at 3 years postoperatively, with no statistically significant differences in knee scores (91.9 vs 92.3 vs 91.8) or range of motion (127.9° vs 128.5° vs 127.7°) between the groups. However, there was a significant difference between Genesis II and Gemini MK II in the Forgotten Joint Score (59.7 vs 62.4). Patients with persistent postoperative anterior knee pain were present in all three groups (16 vs 12 vs 10), but the incidence was not significantly different.

Literature Abstracts

Partial versus intact posterior cruciate ligament-retaining total knee arthroplasty: a comparative study of early clinical outcomes.

Bo Zhang, MD, Cheng-kung Cheng, PhD, Tie-Bing Qu, Yong Hai, PhD, Yuan Lin, PhD, Jiang Pan, MD, Zhi-wei Wang, PhD, Liang Wen, PhD
Orthopaedic Surgery 2016;8:331–337

Objective:

Whether the entire posterior cruciate ligament (PCL) should be retained during cruciate-retaining total knee arthroplasty (CR TKA) is controversial. The goal of this study was to compare the early clinical outcomes of partial versus intact PCL-retaining TKA.

Methods:

Ninety-two patients who had undergone unilateral CR TKA from March 2012 to June 2013 were enrolled in this study. Forty-six of these patients were randomly selected to undergo intact PCL-retaining TKA (intact group), whereas the remaining 46 patients underwent tibial osteotomy together with anterolateral bundle and bone island resection (partial group). All operations were performed by a senior orthopedic surgeon and the PCL was released to some extent in both groups. After TKA, active and passive flexion and extension exercises of the knee and lower limb strength exercises were maintained until at least 3 months after surgery. Before surgery and 6, 12, and 24 months after surgery, range of motion, Knee Society Clinical Rating System scores (including clinical and functional scores of the knee) and maximum anteroposterior (AP) displacement of the knee at 30° and 90° of knee flexion were evaluated in both groups.

Results:

Fourteen patients were rejected from the final analysis because of loss to follow-up or development of complications. Thus, 40 patients from the partial group and 38 from the intact group were followed up for 24–41 months (mean 32.8 months). Knee functional scores were significantly higher in the intact than in the partial group (88.1 vs. 84.8 points) 24 months after surgery. There were no significant differences in range of motion or knee clinical scores between the two groups at any time point. However, 12 and 24 months after surgery, the mean maximum AP displacement of the knee in 90° knee flexion was significantly greater in the partial than in the intact group (12 months: 6.3 vs. 5.7 mm; 24 months: 7.0 vs. 6.2 mm).

	2 yrs Post-op
KSS Clinical Scores	91.9 ±1.8
KSS Functional Scores	88.1 ±1.4
Range of Motion	122.3° ±7.8°

[Overview of all Clinical Studies...](#)

Literature Abstracts

Analysis of interlimb asymmetry in patients undergoing simultaneous bilateral total knee arthroplasty.

Yu Yang, Gong Long, Wang Zhenhu.

PLoS ONE 10(6): e0129783. doi:10.1371/journal.pone.0129783

Objective:

The purpose of the present study was to investigate the risk factors of asymmetric recovery in patients who underwent simultaneous bilateral TKA (SBTKA) and whether that affected quality of life.

Methods:

A total of 187 patients undergoing SBTKA were included. During this study, patients underwent physical examination (knee swelling, active range of motion (ROM) of knee and quadriceps strength) and completed three surveys (VAS pain rating, Short Form-36 and requisite information lists in this study).

Results:

Between-limb differences in active ROM, quadriceps strength, and VAS pain scores were significantly detected in our study. Risk factors included being female, being older, and having high BMI and high levels of anxiety and depression; different diagnosis and different component size could be risk factors. Finally, interlimb differences in VAS pain scores and active ROM were negatively associated with SF-36 scores. However, interlimb differences in swelling and quadriceps strength were unrelated to SF-36 scores. Risk factors of asymmetric recovery should be evaluated and appreciated due to their significant impact on patients' quality of life. Before performing SBTKA, clinicians should consider possible risk factors and inform patients of asymmetric recovery between limbs, which could help decrease the unnecessary consultations and postoperative patient dissatisfaction.

	2 yrs Post-op
VAS Pain Rating	1.15 ± 0.98
Range of Motion	114.5° ± 7.9°

Literature Abstracts

Three different cruciate-sacrificing TKA designs: minor intraoperative kinematic differences and negligible clinical differences.

Simone Bignozzi, Stefano Zaffagnini, Ibrahim Akkawi, Tedi Marko, Danilo Bruni, Maria Pia Neri, Francesca Colle, Maurilio Marcacci

Knee Surg Sports Traumatol Arthrosc (2014) 22:3113–3120

Purpose

The goal of this study was to compare three types of mobile-bearing posterior cruciate ligament (PCL)-sacrificing TKA. The hypothesis was that the three designs provide differences in flexion stability and femoral rollback and improved clinical score at 2-year follow-up.

Methods

Three groups of patients, divided according to implant design, were analysed retrospectively. All operations were guided by a non-image-based navigation system that recorded relative femoral and tibial positions in native and implanted knees during: passive range of motion and anterior drawer test at 90° flexion. WOMAC, KSS and SF36 scores were collected pre-operatively and at 2-year follow-up.

Results

There are no differences in kinematic or clinical performance of the three implants, except for the anteroposterior translation during stress test in flexion: only Cohort B had comparable pre- and post-operative laxity test values ($p < 0.001$). All three TKA designs allowed to maintain pre-operative tibial rotation pattern through all range of knee flexion. All clinical scores of the three patient cohorts were significantly improved post-operatively compared to the pre-operative values ($p < 0.001$). Moreover, we found no differences among post-operative results of the three designs.

Conclusion

Despite design variations, mobile-bearing PCL-sacrificing TKA reproduces femoral rollback and screw-home with little or no difference in clinical or functional scores at a follow-up of 2 years.

[Overview of all Clinical Studies...](#)

Literature Abstracts

Total knee arthroplasty for severe valgus knee deformity.

Zhou Xinhua, Wang Min, Liu Chao, Zhang Liang and Zhou Yixin
Chinese Medical Journal 2014; 127 (6), January 2014

Purpose

Primary total knee arthroplasty (TKA) in severe valgus knees may prove challenging, and choice of implant depends on the severity of the valgus deformity and the extent of soft-tissue release. The purpose of this study was to review 8 to 11 years (mean, 10 years) follow-up results of primary TKA for variant-III valgus knee deformity with use of different type implants.

Material and Methods

Between January 2002 and January 2005, 20 women and 12 men, aged 47 to 63 (mean, 57.19 ± 6.08) years old, with variant-III valgus knees underwent primary TKA. Of the 32 patients, 37 knees had variant-III deformities. Pie crusting was carefully performed with small, multiple inside-out incisions, bone resection balanced the knee in lieu of soft tissue releases that were not used in the series. Cruciate-retaining knees (Gemini MKII, Link Company, Germany) were used in 13 knees, Genesis II Smith & Nephew Company, USA) in 14 knees, and hinged knee (Endo-Model Company, Germany) in 10 knees. In five patients with bilateral variant-III TKAs, three patients underwent 1-stage bilateral procedures, and two underwent 2-stage procedures. All implants were cemented and the patella was not resurfaced. The Hospital for Special Surgery (HSS) knee score was assessed. Patients were followed up from 8 to 11 years.

Results

The mean HSS knee score were improved from 50.33 ± 11.60 to 90.06 ± 3.07 ($P < 0.001$). The mean tibiofemoral alignment were improved from valgus $32.72^\circ \pm 9.68^\circ$ pre-operation to $4.89^\circ \pm 0.90^\circ$ post-operation ($P < 0.001$). The mean range of motion were improved from $93.72^\circ \pm 23.69^\circ$ pre-operation to $116.61^\circ \pm 16.29^\circ$ post-operation ($P < 0.001$). No patients underwent revision. One patient underwent open reduction and internal fixation using femoral condylar plates for supracondylar femoral fractures secondary to a fall at three years. Three patients developed transient peroneal nerve palsies, which resolved within nine months. Two patients developed symptomatic deep vein thrombosis that was managed with rivaroxaban and thromboembolic deterrent stockings. There was no incidence of pulmonary embolism. Postoperative patient satisfaction was 80.7 ± 10.4 points in the groups. Prosthetic survival rate was 100% at mean 10 years postoperative.

HSS	90.06 ± 3.07
Survival Rate @10 yrs	100%
Range of Motion	$116.61^\circ \pm 16.29^\circ$

Literature Abstracts

Less anterior knee pain with a routine lateral release in total knee arthroplasty without patellar resurfacing: a prospective, randomized study.

Guo-Chun Zha, Jun-Ying Sun, Sheng-Jie Dong

Knee Surg Sports Traumatol Arthrosc (2014) 22:517–525

Purpose

Anterior knee pain is a major cause of complaint in total knee arthroplasty (TKA) without patellar resurfacing. The concept of improved patellar tracking and decreased retropatellar contact pressure for lateral retinacular release theoretically suggests that patients with lateral retinacular release in TKA would achieve a lower incidence of anterior knee pain when compared without lateral retinacular release. We sought to determine (1) whether those patients who received a routine lateral retinacular release in TKA would attain lower incidence of anterior knee pain as compared to patients who received TKA without lateral retinacular release and (2) whether lateral retinacular release would increase the lateral retinacular release-related complications.

Methods

A total of 148 patients who underwent TKA with the use of the Gemini MK II mobile bearing were randomized to receive either routine lateral retinacular release (intervention group) or not (control group). Patients were assessed by the visual analogue scale for anterior knee pain, the Knee Society clinical scoring system of knee score and function score, and patellar score for clinical function. Patients' satisfaction and lateral retinacular release-related complications were also evaluated.

Results

The overall incidence of anterior knee pain in the intervention group at 18 months follow-up was 5.6 %, while that of the control group was 20.6 % ($p = 0.009$). No statistical difference was detected between the two groups in terms of lateral retinacular release-related complications (n.s.), patients' satisfaction (n.s.), knee score (n.s.) at 18 months follow-up.

	18 months
Anterior Knee Pain	4 (1 mild 3 moderate) = 5.6%
KSS Clinical Scores	87.1 ± 9.0
KSS Functional Scores	88.1 ± 9.0

[Overview of all Clinical Studies...](#)

Literature Abstracts

Postural stability in relation to anthropometric and functional characteristics in women with knee osteoarthritis following total knee arthroplasty.

Doris Vahtrik, Jaan Ereline, Helena Gapeyeva, Mati Pääsuke
Arch Orthop Trauma Surg (2014) 134:685–692

Purpose

Due to the controversial information about postural stability in patients with lower limb joints osteoarthritis (OA), the following main questions are raised: how serious is the postural stability disturbance and which factors have an impact on postural stability before and after total knee arthroplasty (TKA).

Materials and Methods

Force plate was used to assess postural stability and custom-made dynamometer was used to assess isometric maximal voluntary contraction (MVC) force of leg extensor muscles; besides, knee pain and knee range of motion (ROM) was evaluated in 14 female patients (aged 46–68 years) with knee OA 1 day before, and 3 and 6 months following TKA and once in healthy controls (aged 48–70). Relationship between postural stability during standing and selected anthropometric and functional characteristics were investigated with Spearman's correlation coefficients.

Results

Remarkable reduction of knee pain and improvement in active ROM for the operated leg were shown after unilateral TKA. MVC force of leg extensor muscles achieved the preoperative level half a year after TKA. The centre of pressure (COP) of sway displacement in anteroposterior (AP) and mediolateral direction and the equivalent area of COP sway for the operated leg did not differ before, 3 and 6 months after TKA and compared to the non-operated leg. The trace speed was 6 months after TKA equal to the preoperative level. Only the COP of sway displacement in AP direction is significantly greater in knee OA patients both before and after TKA compared with healthy controls. Conclusions Knee OA patients' postural stability characteristics did not differ significantly both before and after TKA. Compared to healthy controls, the COP of sway displacement in AP direction is mostly disturbed. Correlation analysis confirms that increased postural sway is associated with an increased equivalent area of COP. In knee OA patients higher body mass index ensures reduced trace speed and lower knee ROM.

Knee Pain (VAS) 6 months Post-op	1.5
Range of Motion	104°

[Knee pain was assessed by visual analogue scale (VAS) in points ranging from 0 (no pain) to 10 (unbearable pain)]

Literature Abstracts

Long-term results with different designs in knee replacements.

H. Thabe, M.Dafferner-Franzmann, J. Stening

Akt Rheumatol Online Publication: 21.10.2013 Akt Rheumatol, 2013 - 38

Total knee arthroplasty should be a step forward to restore a natural kinematics of a knee with an adapted anatomy (correct axis and restoring the joint line), an adequate function, a good longevity.

Our task to restore previous anatomic function has its best solution with the sledge prosthesis, as an anatomic restoration of defects in one or more compartments in cases of intact collateral and cruciate ligaments. The step towards resurfacing TKA is a step to restore a knee and correct severe deformities. This kind of prosthesis has to cover a defect in 2 or more surfaces and correct unphysiological function, e. g. by lack of an anterior cruciate ligament, a severe laxity of collateral ligaments by osteonecrosis, axis deviation. If the normal kinematics are gone, our prosthesis has to restore kinematics of a normal knee and guarantee an adequate stress transfer to our new knee. More congruency and therefore low contact stress and PE wear requires an excellent implantation technique and by the way at least more rotational capacity to avoid stress on the fixation especially in rising up from a chair, climbing stairs etc. To mimic natural kinematics is only possible with anatomic designs and freedom of motion (nearly impossible in a strongly defected knee) or predictable femoral motion in roll back with retention of the PCL, posterior stabilized versions with mobile bearings. Fully conforming articulation will lead to dorsal impingement in flexion degrees more than 120 °. Therefore a "hybrid type of mobile bearing TKA" conformity like a conventional fixed bearing knee in combination with rotation capacity does simulate normal kinematics on a high level. The Gemini MK II design with the deep dishd plateau results in a good stabilisation, rotation and at least an excellent alignment for the patella tracking. Together with the denervation and resection of the ramus infrapatellaris of the saphenus nerve our results of anterior knee pain dropped down to only 1.4 %. in late results.

From July 1999 to December 2001 we implanted 771 primary knee arthroplasty. 567 were surface replacement prostheses (TKA) of the type Gemini MK II. 172 unicondylar sledges (157 medial and 15 lateral) in case of unilateral osteoarthritis and in cases of instability 47 Rotational Knee Implants.

In our replacements we got an average range of motion of 0/1/128 °. The HSS score increased from 68.8 to 94.4 postoperation. In cases of severe osseous necrosis and instability due to ligament destructions a so-called rotational hinge prosthesis like the Endo model is our first choice.

Results

HSS	94.4 Points
Survival Rate @11.2 yrs	91.2%
Range of Motion	128°

[Overview of all Clinical Studies...](#)

Literature Abstracts

Gait and muscle strength characteristics in total knee arthroplasty patients with patello-femoral pain syndrome before and six months after surgery.

H. Gapeyeva, J. Ereline, T. Haviko, H. Aibast, M. Pääsuke
Acta Kinesiologiae Universitatis Tartuensis. 2011, Vol. 17; 37-52

Purpose

The aim of the present study was to investigate the gait and muscle strength characteristics in total knee arthroplasty (TKA) patients with patellofemoral pain syndrome (PFPS) before and six months after surgery.

Material and Methods

Eight patients (4 men and 4 women) aged 58–77 years with PFPS following unilateral TKA who had primary degenerative knee OA participated in the study before and six months after reoperation. In patients was registered the active range of motion (AROM) of knee extension and flexion, hip abduction and adduction. Isometric maximal voluntary contraction (IMVC) force of knee flexors, extensors, abductors and adductors was measured and gait kinematic characteristics and kinetic characteristics of knee joint were recorded.

Results

Knee flexion AROM in the involved leg was significantly lower ($p < 0.05$) as compared to the uninvolved leg pre- and post-surgery. The patients had greater ($p < 0.05$) hip abduction AROM and significant increase (31%, $p < 0.05$) of IMVC force of the involved leg's hip abductors postoperatively as compared before surgery. Six months after surgery 38 H. Gapeyeva et al. a significant ($p < 0.05$) improvement of gait spatiotemporal characteristics (increase of swing time and stride length ($p < 0.05$), together with decrease of stance time and cadence, as well increase of stride length) was noted in the involved leg. In TKA patients 6 months after reoperation due to PFPS the knee joint function in involved leg was significantly improved and the positive changes in gait with comfortable velocity took place as compared before surgery.

WOMAC scores of TKA patients with PFPS before and 6 months after surgery:

	Before Surgery				6 months after Surgery			
	mean	SE	min	max	mean	SE	min	max
WOMAC-Pain (0-20)	5.4	1.2	5	12	12.01	1.7	7	19
WOMAC-PF (0-68)	18.0	3.2	7	25	36.1	3.4	16	45

WOMAC – Western Ontario and McMaster Universities Index of Osteoarthritis questionnaire; WOMAC-Pain – pain subscale and WOMAC-PF – physical function subscale (smaller scores characterise greater impairment of function; estimation involved recent 48 hours before testing). Data are presented as mean $\pm$ SE and range (minmax). ** $p < 0.01$ as compared with data before surgery.

Literature Abstracts

Quadriceps femoris muscle voluntary isometric force production and relaxation characteristics before and 6 months after unilateral total knee arthroplasty in women.

Helena Gapeyeva, Nele Buht, Katrin Peterson, Jaan Ereline, Tiit Haviko, Mati Pääsuke

Knee Surg Sports Traumatol Arthrosc (2007) 15:202–211

Purpose

The present prospective intervention study was to evaluate voluntary isometric force production, relaxation and activation capacity of the quadriceps femoris (QF) muscle before and 6 months after unilateral total knee arthroplasty (TKA).

Material and Method

TKA was performed in ten women with primary knee osteoarthritis (OA) using the condylar endoprotheses. Isometric maximal voluntary contraction (MVC) force, rate of force development at 50% of MVC (RFD50) and their ratio to body mass, half relaxation time (HRT) and voluntary activation (VA) of the QF muscle were recorded in patients for operated and non-operated leg before and 6 months after TKA. Established characteristics were compared with data on the dominant leg of ten age- and gender-matched controls. The clinical examination was performed using the Knee Society System (KSS) scores and pain intensity was assessed by visual analogue scale.

Results

MVC force in operated leg was lower ($P < 0.05$) before and 6 months after TKA as compared with the non-operated leg (31 and 32%, respectively) and controls (48 and 44%, respectively). Patients had lower ($P < 0.05$) VA of the QF muscle in operated leg 6 months after TKA as compared to controls. Significant increase ($P < 0.05$) of KSS clinical scores and the tendency for the increasing of explosive force production of QF muscle in the operated leg were observed 6 months after TKA (RFD50 was 60% lower before TKA and 40% lower 6 months after surgery as compared to controls). When compared with the preoperative value, HRT prolongation ($P < 0.05$) was noted 6 months after TKA in QF muscle of both legs in patients. Therefore, the present study confirmed that patients with knee OA had reduced force generation ability of QF muscle before TKA and the improvement of explosive force was noted 6 months after surgery.

Range of Motion	128°
HSS @7.3 yrs	96.1
Pain Finding	0.8%

[Overview of all Clinical Studies...](#)

Literature Abstracts

Early stages clinical application of GEMINI PS total knee arthroplasty.

Chen Q.

Chin J Bone Joint Injury. 2012;27

Purpose

To report the clinical experience of GEMINI PS total knee arthroplasty (TKA).

Material and Method

The LINK's knee prosthesis GEMINI PS TKA line was used to treat knee disorders in 28 cases 32 knees). Preoperative and postoperative HSS score, pain score knee flexion and range of motion score was analyzed and evaluated.

Results

GEMINI PS total knee arthroplasty can improve knee pain and function and can improve joint range of motion in the short term after surgery, to achieve high flexion state. The indications for surgery depend on the choice of prosthesis design improvements, mature surgical technique and good postoperative rehabilitation.

Observation item	Pre-surgery	3 weeks after surgery	3 months after surgery	6 months after surgery	Final follow-up
HSS score	51.8 ± 5.8	88.6 ± 6.2	89.9 ± 4.6	90.8 ± 6.4	92.3 ± 5.4
Knee joint flexion degree (°)	95.4 ± 11.9	120.5 ± 9.4	122.6 ± 8.7	125.6 ± 7.2	127.5 ± 6.9
Pain score	9.8 ± 4.2	25.6 ± 2.2	26.3 ± 2.2	27.2 ± 1.2	27.3 ± 2.1
Motion degree score	11.9 ± 1.2	15.1 ± 0.9	16.1 ± 0.8	16.3 ± 0.7	16.4 ± 0.6

Literature Abstracts

Gait analysis after total knee arthroplasty with posterior cruciate ligament retention rotating platform and fixed total knee arthroplasty.

Liu QG, Pan H, Liu Z, Wang JJ, Wang F, Wang P, Shi QL, Guo J, Li L.
Indian J Pharm Sci. 2021;83 *Chin J Bone Joint Injury.* 2012;27

Purpose

To investigate the gait analysis of patients after total knee arthroplasty with posterior cruciate ligament retention rotating platform and fixed total knee arthroplasty, so as to provide ideas for clinical rationalization treatment.

Material and Method

A total of 82 patients with posterior cruciate ligament preserving rotating and fixed platforms were selected for knee replacement in our hospital and were followed up for 1 y. The knee joint Hospital for special surgery score, Western Ontario and McMaster Universities Osteoarthritis index score and the application of a three-dimensional motion capture system were used to compare the parameters of knee joint kinematics and dynamics.

Results

In the application of knee arthroplasty between the posterior cross retained rotating platform and the fixed platform, the temporal and spatial parameters and motion parameters in the knee function and gait analysis were significantly improved compared with those before the operation and the differences were statistically significant ($p < 0.05$), while there was no statistically significant difference between the two groups ($p > 0.05$). Both rotating platform and fixed platform can significantly improve the knee joint function and gait of patients with knee arthroplasty using posterior cruciate ligament retention prosthesis.

	Pre-surgery	1 year after surgery
HSS score	58.11 ± 10.61	82.14 ± 7.60
WOMAC score	63.14 ± 7.60	22.21 ± 3.45

[Overview of all Clinical Studies...](#)

Literature Abstracts

Knee pain and postural stability in women with gonarthrosis before and six month after unilateral total knee replacement.

Rätsepsoo M, Gapeyeva H, Vahtrik D, Aibast H, Ereline J, Haviko T, Märtson A, Pääsuke .
Acta Kinesiologiae Universitatis Tartuensis. 2012, Vol. 17

Purpose

The aim of this study was to investigate knee pain and postural stability in women with knee osteoarthritis (OA), who used postoperative home exercise program (HEP) with balance exercises.

Material and Method

14 women with knee OA in stage III–IV (aged 48–70 years) participated in this study before and 6 months after unilateral total knee arthroplasty (TKA). All patients performed HEP during 6 months after unilateral TKA. Data of patients was compared with healthy age-matched women (controls, n=10). Postural stability characteristics (centre of pressure (COP) displacement in the anterior-posterior (AP) and mediolateral (ML) direction, COP sway equivalent radius and area) during 30 s bipedal standing (eyes open) were recorded on two dynamographic force plates. Pain in knee joint was estimated with visual-analogue scale.

Results

COP displacement in AP direction of the operated and non-operated leg was greater ($p<0.05$) in women with knee OA before and 6 months after TKA compared to the controls. Knee joint pain in the operated leg reduced 70% after TKA. TKA together with HEP has an important role in preserving postural stability and reducing knee joint pain in women with III–IV stage gonarthrosis.

Literature Abstracts

Good five year radiological and AKS results with knee replacement by use of rotating platform knee prosthesis.

Sarap P, Haviko T, Kool P, Tootsi K, Parv M, Maasalu K, Märtson A.

Conference Presentation- Poster. Nordic Orthopaedic Federation congress 2014

Purpose

To determine survival of bicondylar rotating knee prosthesis (LINK Gemini). Evaluate diminishing pain and improvement of function in 1, 2 and 5 years postoperatively. Perform radiological evaluation of prostheses.

Material and Method

A prospective study, where data were collected from 50 (39 female (76%), 11 male (243/o), consecutive arthroplasties. Surgeries were performed at Tartu University Hospital in 2008 by 6 orthopaedic surgeons. Clinical investigation consisted of: signing informed consent, taking history, obtaining data for AKS score and to 100-point visual analogue scale (VAS). AKS consists of various elements: knee pain, stability, range of motion (ROM) and a functional score. The Knee Society Roentgenographic Evaluation System was used for the radiographic evaluation. Data of AKS score were analysed statistically, paired t-test or Wilcoxon signed rank test to detect differences between times were applied.

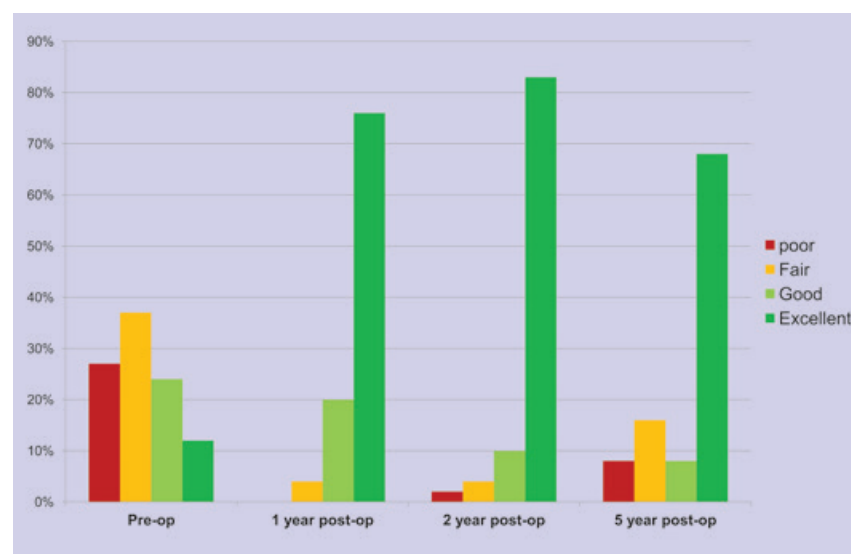
Results

All 50 patients passed 1. and 2. year follow-up, 11 patients were lost to 5 year follow-up. Of these 11: 4 died, 4 were bedridden and 3 refused to participate.

Indication to surgery:

1. Primary osteoarthritis - 903/o
2. Secondary osteoarthritis- 63/o
3. Rheumatoid arthritis - 4%

No revisions due to aseptic loosening or infections. None of the prostheses showed radiological problems. AKS subtotal knee score showed continuous improvement during all observations. AKS postoperative scores were significantly better than preoperative scores Subtotal knee score showed continuous improvement during all observations. Postoperative knee scores 1, 2 and 5 years after operation were significantly better than preoperative scores ($p < 0.01$), with significant improvement even between 1 and 2 years postoperatively ($p = 0.0435$).



[Overview of all Clinical Studies...](#)

Literature Abstracts

The difference of posterior slope angle between intra-operation and post-operation in total knee arthroplasty.

Song X, Dong J, Wang J, Zheng X, Wang Y.
Int J Clin Exp Med 2017;10(2):3406-3410

Purpose

This study aimed to analyze the difference of posterior slope angle between intra-operation and post-operation during total knee arthroplasty (TKA) to provide a theoretical basis for adjusting the posterior slope angle.

Material and Method

Clinical patients (44 cases) with TKA admitted to the Hospital from June 1 to September 2 in 2013 were involved in this study. According to the difference of the prosthesis, patients were divided into two groups: cruciate-retaining group (n=22, 33 knees) and posterior-stabilized group (n=22, 31 knees). Then the difference between posterior slope angle of intra-operation and post-operation were analyzed.

Results

In the cruciate-retaining group, the posterior slope angle of post-operation was $5.73^{\circ} \pm 2.81^{\circ}$ greater than that of intraoperation ($P=0.00$); While in the posterior-stabilized group, the posterior slope angle of post-operation was $1.66^{\circ} \pm 1.43^{\circ}$ greater than that of intra-operation ($P=0.00$). In the cruciate-retaining group, the posterior slope angle of post-operation is much smaller than the intra operation which indicating that there is no need to adjust the posterior slope angle when it is too small during intra-operation. As for the posterior-stabilized group, there was no statistical difference of posterior slope angle between post-operation and intra-operation, so we could predict the posterior slope angle of post-operation according to that of intra-operation.

Literature Abstracts

Primary effect analysis after total knee arthroplasty using Gemini PS prosthesis.

Wang J, Chen W, Guan, H, Pan D.

Journal of Clinical Orthopaedics and Trauma. 2012;15Int J Clin Exp Med 2017;10(2):3406-3410

Purpose

To analyze the primary effect after total knee arthroplasty (TKA) using the Gemini PS prosthesis.

Material and Method

20 patients (20 knees) were treated with TKA. At each follow up recorded the knee score, pain score, function score, patellar score and the range of maximum genuflex .

Results

All patients were followed up with 12 months period. Pain and function of patients were obviously improved after operation, especially in pain and range of knee activation . The score of HSS , patellar , anterior pain of knee, function of patellar and the maximum genuflex were increased significantly than those before operation ($P < 0.01$).

	Pre-surgery	12 months after surgery
HSS score (100)	58.60 ± 7.89	82.14 ± 7.60
Motion degree score (18)	63.14 ± 7.60	22.21 ± 3.45
Patella score (15)	18.50 ± 3.81	27.20 ± 1.60
Anterior knee pain	6.50 ± 2.85	12.75 ± 2.22
Patella function (10)	4.90 ± 1.16	8.30 ± 1.26
Strength of quadriceps femoris (5)	2.70 ± 1.34	4.10 ± 0.62

[Overview of all Clinical Studies...](#)

Literature Abstracts

A prospective study concerning the relationship between metal allergy and post-operative pain following hip and knee arthroplasty.

Zeng Y, Feng W, Li J, Lu L.

International Orthopaedics (SICOT). 2014;38:2231-6

Purpose

A prospective study was conducted to detect whether a relationship exists between metal allergy and postoperative pain in total hip and knee arthroplasty patients. We postulated that to some extent a relationship does exist between them.

Material and Method

Patients who had undergone total hip and knee arthroplasty surgery because of hip and knee disease were included. The exclusion criteria were patients who were treated with immunosuppressor two weeks preoperatively, skin conditions around the patch testing site, and other uncontrollable factors. Each patient agreed to patch testing for three days before surgery. Photographic images before patch testing, two and three days after patch testing were obtained to evaluate the final incidence of metal allergy. The patch tests contained 12 metal elements; chromium, cobalt, nickel, molybdenum, titanium, aluminium, vanadium, iron, manganese, tin, zirconium, and copper. Two independent observers evaluated the images. The results were divided into a nonmetal allergy group and a metal allergy group. Pre-operative and postoperative VAS score, lymphocyte transforming test, and X-rays were collected to detect the relationship between metal allergy and post-operative pain following total hip and knee arthroplasty.

Results

There were 96 patients who underwent pre-operative patch testing. The overall metal allergy rate was 51.1 % (49/96) in our study. Nickel, cobalt, manganese, and tin were the most common allergic metal elements in our study. Nine inappropriate cases were excluded, and 87 patients were finally included in our study. There were 36 metal allergy and 26 non-metal allergy patients in the THA group, while 11 metal allergy and 14 non-metal allergy patients were found in the TKA group. We found no relationship existed between metal allergy and post-surgery pain in total hip and knee arthroplasty.

Literature Abstracts

The effect of femoral prosthesis design on patellofemoral contact stresses in total knee arthroplasty: a case-control study with mid-term follow-up minimum 3-year follow-up.

Kong L, Lin W, Kang H, Li M, Hao K, Chnag B, Wang F.
Journal of Orthopaedic Surgery and Research. 2023;18:781

Purpose

To investigate the differences in postoperative patellofemoral pressures and patellar tracking during at least three years of follow-up in patients using three prostheses of different designs in total knee arthroplasty (TKA) without patellar resurfacing.

Material and Method

The study included 401 patients who had a total of 480 knee prostheses implanted without patellar resurfacing. The prostheses used were Genesis II (external rotation design of femoral prosthesis), Triathlon (design with deep trochlear grooves), and Gemini MK II (deepening of trochlear groove and lateral condylar protrusion that closely follows the anatomical shape). The patients' patellar tracking was assessed by measuring patellar tilt and displacement during postoperative follow-up. Furthermore, postoperative knee function and pain were evaluated through range of motion, Knee Society scores (KSS), and Forgotten Joint Score (FJS) to compare the different groups.

Finite element analysis: Constructing a finite element model of the knee joint of a normal volunteer after total knee arthroplasty using different prostheses for nonpatellar replacement. The three models' von Mises stress distribution heat map, peak contact pressure, and patellar transverse displacement were compared at 30°, 60°, and 90°, respectively.

Results

A total of 456 knees of 384 patients were investigated at a 3-year follow-up after TKA without patellar resurfacing. There were no significant differences in patellar tracking between the three groups. Patients with all three prostheses demonstrated favorable clinical outcomes at 3 years postoperatively, with no statistically significant differences in knee scores (91.9 vs 92.3 vs 91.8) or range of motion (127.9° vs 128.5° vs 127.7°) between the groups. However, there was a significant difference between Genesis II and Gemini MK II in the Forgotten Joint Score (59.7 vs 62.4). Patients with persistent postoperative anterior knee pain were present in all three groups (16 vs 12 vs 10), but the incidence was not significantly different..

	36 months postoperative follow-up
Knee score	91.9 ± 2.9
Function score	85.1 ± 5.2
Knee range of motion (°)	127.9 ± 10.6
Forgotten joint score	62.4 ± 8.9
Anterior knee pain	12

[Overview of all Clinical Studies...](#)

Biomechanical Studies

GEMINI SL Mobile Bearing / Fixed Bearing CR Biomechanical analysis in healthy and deficient PCL patient

Bernardo Innocenti, PhD

LINK 999_WP_003_2017_Gemini-SL_en, 2019

Purpose

The purpose of this analysis was to analyze the biomechanics of the GEMINI SL MB design and of the GEMINI SL FB CR design (Figure 1) during squat activities, using finite element analysis (FEA), and to check the performance in a patient with a healthy PCL and in a patient with a deficient PCL.

Material and Methods

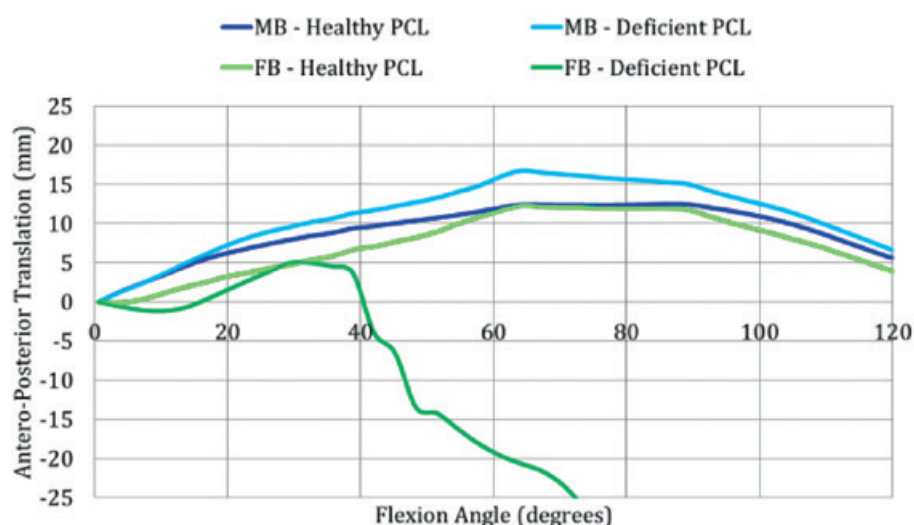
A GEMINI SL Fixed Bearing CR and a GEMINI SL Mobile Bearing, both right side, size medium, were selected for this study and implanted following, for each, the proper indication provided by the manufacturer. A 10 s loaded deep squat, up to 120°, was simulated. The boundary conditions of this movement, in terms of flexion-extension angle, axial and anterior-posterior force, were taken accordingly to previously experimental activities.

Even if the patellar bone and soft tissue envelope was not model in the present activity the adopted boundary conditions take in account also of forces exerted by the extensor mechanism. Similarly to the experimental tests, the other degrees of freedom were kept free.

Results

In this study the GEMINI SL MB design and of the GEMINI SL FB CR design were analyzed during squat using a validated finite element analysis. Results demonstrate how the high congruency of the MB design is able to guarantee the knee stability even when the PCL is deficient. Contrariwise, the FB insert, with a lower congruency is not able to stabilize the joint inducing an irregular kinematic pattern and enabling the dislocation of the components.

This findings are in accordance with clinical indications provided by the manufacturer.



[Overview of all Biomechanical Studies...](#)

Biomechanical Studies

Biomechanical analysis of GEMINI SL total knee replacement implant designs up to 155° of flexion

Bernardo Innocenti, PhD

LINK 999_WP_001_2017_Gemini-SL_en, 2019

Purpose

In our study, we investigated the proximal interface on the UHMWPE insert contact surface areas and pressures of the GEMINI SL total knee replacement implants, using finite element analysis, throughout the range of motion from 0° to 155° of flexion with a standardized testing protocol and compare with the contact pressure and area of competitor High-Flex design analyzed under the same boundary conditions.

Material and Methods

A right side, size medium, was selected for each design.

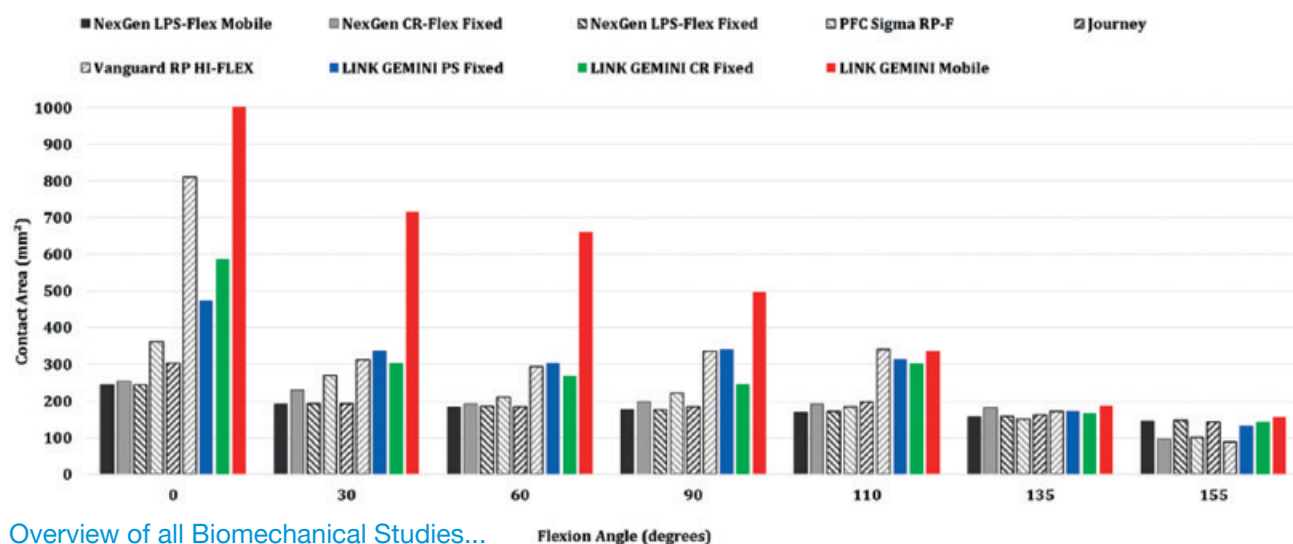
According to previous studies, linear elasticity was used for all the material models considered in this study. This allows for a good approximation of all the involved materials in order to gain a qualitative comparison among different configurations. The materials of the metal components, and tibial insert were respectively cobalt-chromium alloy (CoCr), and an ultra-high-molecular-weight-polyethylene (UHMWPE). The materials were assumed to be homogeneous and isotropic. The material properties were: for CoCr: $E = 240$ GPa, $\nu = 0.3$ and for UHMWPE: $E = 0.7$ GPa, $\nu = 0.4$. Following a standardized testing protocol⁷⁻⁹, a load of 3600 N, corresponding five times the body weight of 73 kg person was applied at 0°, 30°, 60°, 90°, 110°, 135° and 155° of flexion, and the contact area and pressure were recorded. This load is approximately five times the body weight of a 73 kg person and was selected based on a report which demonstrated that three to six times the body weight is applied to the tibiofemoral joint during level walking and descending stairs. Each model was meshed using tetrahedral elements with an average element size of 1.5 mm. A convergence test was preliminary performed to check the mesh quality. Abaqus/Standard version 6.13-1 (Dassault Systèmes, Vélizy-Villacoublay, France) was used to perform all the finite element simulations.

Results

This study, using a validated finite element modeling and applying the same boundary conditions of a previous experimental study on different high-flex competitor designs, demonstrate that LINK GEMINI SL designs behave similarly to Hi-Flex competitor design.

In particular:

- between 0° and 110°, the behavior is in general better than competitor designs both in relation to contact area (that is higher) and contact pressure (that is smaller)
- at 135° and 155° of flexion the behavior is similar as the other competitor designs both in relation to contact area and contact pressure.



Biomechanical Studies

GEMINI SL Fixed Bearing PS: Biomechanical Analysis of the Post-Cam System

Bernardo Innocenti, PhD

LINK 999_WP_002_2017_Gemini-SL_en, 2019

Purpose

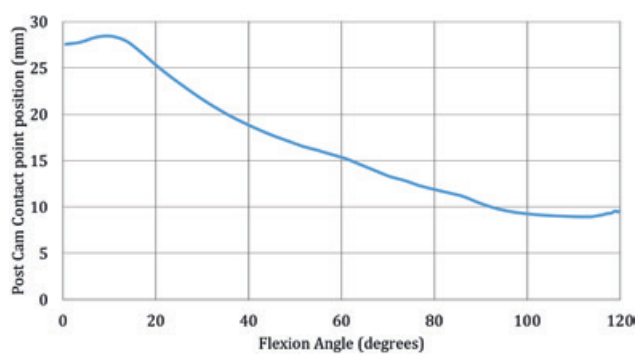
The purpose of this analysis was to analyze the biomechanics of the GEMINI SL Fixed Bearing PS during squat activities, using finite element analysis (FEA), and compare the results with the one achieved, under the same boundary condition, by different competitor's PS TKA design.

Material and Methods

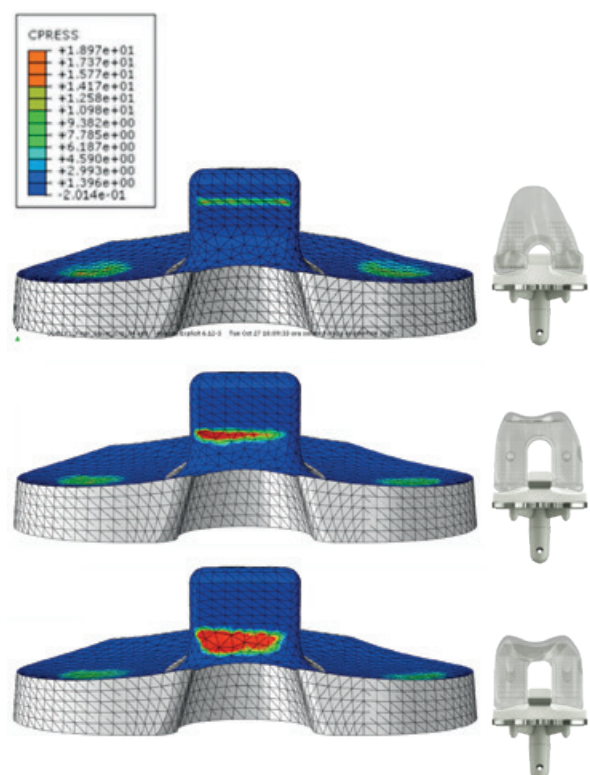
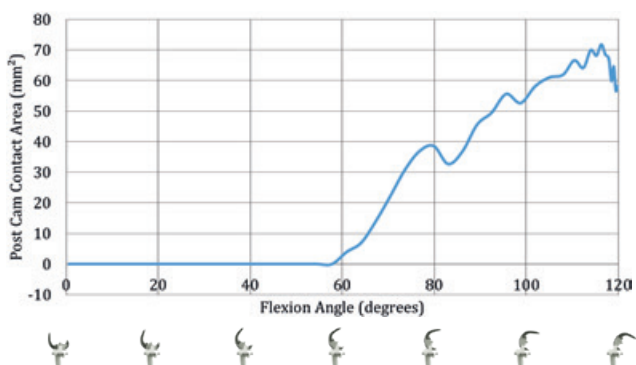
The Finite element model was based on an already validated and published knee finite element model 3-5 A GEMINI SL Fixed Bearing Posterior Stabilized, right side, size medium, was selected for this study and implanted in the femoral and tibial bone following the proper indication provided by the manufacturer. A 10 s loaded deep squat, up to 120°, was simulated. The boundary conditions of this movement, in terms of flexion-extension angle, axial and anterior-posterior force, were taken accordingly to previously experimental activities in which different competitor's PS TKA design were analyzed. Even if the patellar bone and soft tissue envelope was not model in the present activity the adopted boundary conditions take in account also of forces exerted by the extensor mechanism. Similarly to the experimental tests, the other degrees of freedom were kept free.

Results

The finite element analysis indicated that the post-cam mechanism and design of the GEMINI SL Fixed Bearing PS is very reliable, effective and safer. In particular, during flexion, the position of the contact point lower its position during flexion, reducing the risk of dislocation, the contact area is increasing reducing the contact pressure, reducing the risk of fracture and wear. Moreover, the engagement of the post-cam is in agreement on experimental study on native knee.



Vertical post-cam contact point position during flexion.



Post-cam contact areas at low flexion (upper picture), middle flexion (middle picture) and at higher flexion (lower picture).

[Overview of all Biomechanical Studies...](#)

Registry Data

Swiss National Joint Registry

SIRIS Report 2023 – Annual Report of the Swiss National Joint Registry, Hip and Knee)

Registry	Year of Publication	No of Patients	Survival Rate (%) after 2 yrs
SIRIS	2023	128	99.2%

Since 2012, 154,413 TKA have been registered in SIRIS. Incidence of TKA has steadily grown over the years, but the yearly increase reached 13.8% in 2022.

Demography

The baseline figures indicate that most demographic variables showed little change in recent years. Namely the share of operations performed on women (59.7%) and the mean age at surgery of 69.6 years remained constant. Generally, women were older than men when receiving a TKA, with the difference steadily decreasing with age. The difference in younger patients was mainly due to men's higher share of post-traumatic OA. Differences in patient demographics, including BMI and ASA status, were small and not significant between low or high-volume hospitals. The most frequent indication for TKA was classified as primary OA, representing 88.1% of the cases in the period from 2017 to 2022. Since 2013, 13.1% (11,390) of all cases examined were classified as secondary OA. The mean age at surgery was significantly lower, at 65.0 years, compared to TKA for primary OA, where the mean age was 70.2 years. The share of women amounted to 47.3% for secondary and 61.4% for primary OA. Patients older than 65 years were less frequently classified as secondary OA. Younger age was the main difference between primary and secondary OA responsible for apparent differences in revision TKA.

Other factors like BMI and ASA classification did not differ between the two groups.

67.5% of the knees were never operated on before TKA, and for the remaining patients, the previous operations mostly comprised arthroscopies (15.9%), meniscectomy (17.6%), ACL reconstruction (4.9%), and osteotomies of the tibia (2.7%). Arthroscopies and meniscectomies were registered for half of the cases (51%) independently of each other, but in approximately 49% of the cases, they were registered in combination. This may lead to the conclusion that previously half of the meniscectomies were performed by arthroscopy, and the other half by open resection. The rate of arthroscopies preceding TKA in primary OA was constantly decreasing over the past 10 years, with the share being much higher in secondary OA. Post-traumatic cases after tibial or femoral fractures close to the knee were responsible for only 1.9% of the TKA cases and other surgeries before TKA were rare.

Knee systems

The classification of the TKA systems was adapted in 2021 with the last revision of the CRF, because of previously confusing terms. Between 2017 and 2022, the share of cruciate-sacrificing/ultracongruent systems (CS/UCOR) was 25.9%, for posterior stabilized (PS) it was 28.2% and posterior cruciate-retaining (PCR/CR) it was 25.8%. A medial pivot (MP) was used in 15.1%, whereas constrained condylar knees or hinged implants were only used in 1.4% and 1.9% of cases, respectively. Bicruciate-retaining knees (BCR) were rarely used (1.0%) as well. Of particular note is the fact that the knee replacement systems used varied significantly between cantons, regions, and hospitals. Traditionally, posterior stabilized (PS) knees were more present in the western

part of Switzerland, whereas in the German-speaking cantons, cruciate-retaining (CR) and sacrificing (CS), including ultracongruent (UCOR) knees were favoured. Medial pivot (MP) knees did not seem to follow a particular regional pattern but seemed preferred in specific hospitals. The share of medial pivot implants seems to increase and replace more traditional designs such as PS, CR and CS/UCOR

The rate of mobile-bearing polyethylene (PE) liner did rapidly decrease over the past six years, from 41.2% in 2017 to 21% in 2022. However, one must note that the choice of bearing type showed again a high variation in the different cantons of Switzerland, including the Principality of Liechtenstein. The reduction of the mobile bearing system is not a general effect but is more because some hospitals in many cantons changed their knee systems. In contrast, the share of mobile bearing liners even increased in some cantons like UR, JU, TI and FL.

Fixation
Most TKA in Switzerland were fully cemented, accounting for 78.4% over the past six years. Hybrid fixation of the components was used constantly, accounting for a mean of 15.6%. Interestingly, cementless fixation only comprised 5.7% of the TKA since 2017, although the share doubled in 3 years to 8.5% in 2022.

Registry Data

R.I.P.O.

Registro dell'implantologia Protesica Ortopedica (Register of the Orthopaedic Prosthetic Implants)

Registry	Year of Publication	No of Patients	Survival Rate (%) after 10 yrs
R.I.P.O.	2023	2683	94.7

During 2017, with Regional Law n.9 of 1st June 2017, RIPO was recognized as a significant regional interest Register, with the aim of guaranteeing an active and systematic collection of demographic, health and epidemiological data. According to these aims, we are now presenting the 20th report, elaborated by the Register of Orthopaedic Prosthetic Implantology (RIPO). It presents the most significant results of the descriptive and survival statistical analyses performed on hip, knee and shoulder arthroplasty surgeries carried out in the Emilia-Romagna region, in Italy, between 1st January 2000 and 31st December 2020.

This report presents the overall regional data for the following orthopaedic surgeries:

- hip: total arthroplasty, hemiarthroplasty, resurfacing, revision and removal operations;
- knee: uni-, bi- and tricompartmental arthroplasty, revision and removal operations;
- shoulder (since July 2008): anatomical and reverse arthroplasty, resurfacing, partial, revision and removal operations.

Altogether, data of approx. 210000 hip, 131000 knee and 10000 shoulder prostheses have been reported from 69 Orthopaedic Units in 63 Hospitals, either public or private.

During 2020, data on 5662 primary knee prostheses and 930 partial or total revision were registered, with a decrease of 26% of primary bi-compartmental knee prostheses, 16% unicompartmental and 15% of revisions from the past year, due to COVID-19 pandemic. High percentage of knee prostheses is implanted in private structures: 77% in 2020 of primary knee prostheses (vs 43% in 2000) and 63% in 2020 of revision (vs 25% in 2000). In 20120, 14% of implanted prostheses are unicompartmental, 51% are bicompartmental with no patella resurfacing and the remaining 35% have patella resurfacing. The number of prostheses with patella are increasing, in particular in public hospital. Female patients are about twice as many as men. In 2020, 97% of implants are cemented, in the half of them cement is antibiotic loaded. Hybrid fixation is almost completely absent. Mobile insert are decreasing (10% in 2020). 54% of insert are in Standard Poly and the remainig are in Crosslinked Poly with or without antioxidant. Femoral component with Co-Cr are decreasing, Ceramicised Zirconium alloy and Cobalt alloy treated are preferable. Types of implanted prostheses are fewer and more stable during years compared to hip implants. Survival of bicompartmental is 93.1% at 15 yrs, survival of tricompartmental is 94.0% and survival of unicompartmental is significantly lower (82.2%). In these analyses patella resurfacing after primary TKA is considered as a failure. The incidence of revisions due to infection in the prosthesis is high, in particular in total implants, where it represents approximately a quarter of the causes of failure (21%). In total implants, septic loosening represents one-third of causes of failure. Total revisions are not revised the second time in 80.6% of cases at 15 yrs. Cox multivariate analysis shows that the survival of bi-tricompartmental knee prostheses is negatively influenced by age of the patient (the expectancy of prosthesis survival is lower for patient less than 60 yrs), by gender (survival is lower for male patients) and by type of insert (mobile insert is worse than fixed insert). In unicompartmental implants, age of the patient influences negatively survival. Some models of prosthetic have survival slightly below the regional average, as in previous report.

[Overview of all Registry Data Survival Rate...](#)

Registry Data

EPRD

Endoprothesenregister Deutschland

Registry	Product Configuration	Year of Publication	No of Patients	Survival Rate (%) after 6 yrs
EPRD	CR	2024	416	91.5%
	PS	2024	768	92.8%

A total of 155,859 primary knee joint implantations were registered in the EPRD for 2023. Compared to patients who receive a hip replacement, patients who receive a knee replacement tend to be younger, but have a median body mass index that is about three points higher. In the younger age groups, the BMI of patients tends to be slightly higher. There are also some trends in the area of primary knee replacement in relation to the different types of treatment:

- In the EPRD, most treatments have always been fully cemented. However, the proportion of fully cemented treatments continues to rise for TKA treatments (now 96.0% compared to 90.7% in 2016), while it has fallen slightly for unicondylar treatments (83.4% compared to 88.4% in 2020). In the case of TKA, the hybrid anchoring form has lost its share, while in the case of unicondylar treatments, the completely cementfree anchoring has gained in importance. For both total endoprotheses and unicondylar treatments, the share of systems with a mobile platform in the EPRD is lower than ever before, albeit at different levels: In the documented TKA treatments, a mobile platform was recently used in 8.1% of procedures (compared to 19.2% in 2015), and in the case of unicondylar treatments it was still 53.7% (compared to 67.9% in 2015).
- In the case of TKA treatments, the use of cruciate retaining systems in the EPRD has decreased over the years. While a CR system was still used in 52.2% in 2015, the figure for 2023 was only 42.5%. In contrast, the use of PS and pivot systems has increased (PS from 15.8% to 25.5%, pivot from 2.1% to 5.3%).
- A trend towards the use of highly cross-linked PE insert components can also be observed in knee replacements. However, this trend is not as pronounced as in hip arthroplasty. In the area of TKA, the use of hXLPE inserts without or with antioxidants has increased continuously (from 8.0 and 3.5% respectively in 2015 to 13.4 and 14.1% respectively in 2023). In the area of unicondylar restorations, the proportion of hXLPE inserts enriched with antioxidants increased from 0 to 15.4% during the same period, while the proportion of hXLPE inserts without antioxidants decreased from 9.7% to 5.4%.

[Overview of all Registry Data Survival Rate...](#)

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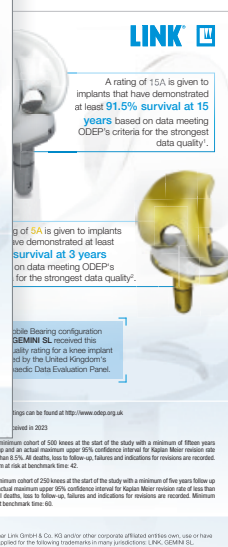
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Further Information

**GEMINI SL Total Knee System**

- Surgical Technique, Implants & Instruments
- Teaserflyer

**GEMINI SL**

- ODEP-Rating
- Teaserflyer

**GEMINI SL SPAR-K**

GEMINI SL Total Knee System
with SPAR-K Instruments

- Surgical Technique, Implants & Instruments
- Teaserflyer



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