Early results of total knee arthroplasty with a low contact stress anteroposterior glide

Adrian J Bauze,1,2 Mark S Falworth,1,3 Roger D Oakeshott1
1 SPORTSMED•SA, Stepney, Adelaide, Australia
2 Department of Orthopaedics and Trauma, University of Adelaide, Australia
3 Royal National Orthopaedic Hospital NHS Trust, Stanmore, Middlesex, United Kingdom

ABSTRACT

Purpose. To present early results of 400 consecutive low contact stress (LCS) anteroposterior (AP) glide total knee arthroplasties (TKAs) performed by a single surgeon.

Methods. 304 consecutive patients aged 30 to 96 (mean, 66) years underwent 400 TKAs using LCS AP glides performed by a single surgeon. Only patients with an intact posterior cruciate ligament, a fixed flexion deformity of <15º, and a valgus deformity of <15º were included. Patients were assessed pre- and post-operatively using the American Knee Society (AKS) and Hospital for Special Surgery (HSS) scores. Range of motion was measured using a goniometer. AP and lateral radiographs were assessed for radiolucencies and osteolysis.

Results. The mean follow-up period was 4.2 (range, 1–8) years. The mean fixed flexion improved to 1º from 11º and the mean active flexion improved to 120º from 111º. Both AKS and HSS scores improved significantly. There were 28 anterior soft tissue impingements; 9 of them were in the first year of the study. Thereafter, the anterior lip of the bearing was modified and any offending osteophytes, soft tissue, or fat pads were excised. Of 39 (10%) knees that underwent re-operation (16 were due to anterior soft tissue impingement), 20 (5%) did not require change of the AP glide bearing and the remaining 19 were converted to a rotating platform bearing. No patellar baja was noted after fat pad excision. No patient had catastrophic wear or failure of the polyethylene bearing. The survival rate of the AP glide bearing was 95%.

Conclusion. The early-to-mid-term outcomes of the LCS AP glide TKA are promising.

Key words: arthroplasty, replacement, knee; posterior cruciate ligament

INTRODUCTION

The low contact stress (LCS) mobile bearing total knee
prosthesis was designed with tibial components for posterior cruciate ligament (PCL) retention (meniscal bearing) or sacrifice (rotating platform). The rotating platform is superior to the meniscal bearing with respect to longer-term survival, and is a common total knee arthroplasty (TKA) prosthesis worldwide. The rotating platform has a highly conforming articular surface and enables free rotation of the tibial insert, but has a limited range of anteroposterior (AP) translation (mainly from the femoral component sliding on the surface of the polyethylene insert).

The LCS AP glide bearing is a modification of the rotating platform to enable AP gliding (between the highly polished surface of the tibial tray) on a control arm and rotational movement (under the surface of the flat polyethylene tibial insert) via the cone-shaped insert on the tibial stem (Fig.). A greater range of motion, particularly high flexion, is enabled. We present early results of 400 consecutive LCS AP glide TKAs performed by a single surgeon with 99% follow-up.

MATERIALS AND METHODS

Between November 1997 and December 2003, 304 consecutive patients aged 30 to 96 (mean, 66) years underwent 400 TKAs using LCS AP glides performed by a single surgeon. 196 left and 204 right knees (211 in women and 189 in men) were operated on. The LCS AP glide is a PCL-retaining bearing, and therefore only patients with an intact PCL, a fixed flexion deformity of <15°, and a valgus deformity of <15° were included. The preoperative diagnoses included osteoarthritis (n=381), post-traumatic osteoarthritis (n=9), rheumatoid arthritis (n=6), psoriatic arthritis (n=3) and systemic lupus erythematosus (n=1).

Patients received preoperative antibiotic prophylaxis with gentamicin 240 mg (if renal function allowed) and cephalothin 2 g on induction and cephalothin 2 g 6 hourly until the drains were removed. A tourniquet was used after exsanguination using an Esmarch bandage. All patients received thromboprophylaxis with either clexane 20 mg once daily for low-risk patients or twice daily for high-risk patients (those with a history of deep vein thrombosis, pulmonary embolism, obesity, varicose veins, hypercoagulability states, malignancy, nephrotic syndrome, polycythemia, or paraproteinemia).

The surgical technique was standardised to minimise variability. A midline skin incision was made through a medial parapatellar tendon approach. Soft tissues were released in a stepwise manner to achieve ligamentous balance in extension. Thus, flexion and extension gaps were approximately equal. Sufficient laxity was achieved to enable full extension and flexion and anterior translation, but not too loose to cause abnormal AP motion with resulting impingement or bearing spin out. Stability was reassessed after each release. Tensioning devices were not routinely used. The proximal tibia was resected with the anterior cruciate ligament sacrificed. The PCL was preserved with a bone block or recessed if not feasible. Additional femur was resected in cases of a flexion contracture. All femoral components were uncemented. The tibial component was uncemented in 394 knees and cemented in 6 (because of severe osteoporosis). The patella was not routinely resurfaced; only 32 were resurfaced (21 of them being uncemented) based on their pathological appearance and whether tracking with the femoral component was stable. Before wound closure, the inferior pole of the patella was inspected for the presence of impingement, and any offending osteophytes, soft tissue, or fat pad was excised.

Rehabilitation was standardised and began on day 1. It entailed a continuous passive motion (0°–90°) exercise for 3 hours per day, regular cryotherapy in the form of ice application or knee cryo/cuff and gait training. Drains were removed on day 2.

Patients were assessed pre- and post-operatively using the American Knee Society (AKS) and Hospital for Special Surgery (HSS) scores. Range of motion was measured using a goniometer. The functional level was classified using a modification of the Merle d’Aubigne classification to determine whether the presence of any co-morbidities influenced functional outcome. AP and lateral radiographs were assessed for radiolucencies and osteolysis according to the AKS score. Data were collated and interpreted by a single researcher to minimise intra-observer error.
RESULTS

The mean follow-up period was 4.2 (range, 1–8) years. 395 (99%) knees were followed up for at least one year. Five patients were lost to follow-up. 360 knees were followed up clinically and radiologically; others were followed up by telephone interview (24 knees), letters (2 knees), via the patient’s general practitioner (1 knee), and via deceased patients’ relatives (8 knees).

The mean fixed flexion improved to 1º from 11º and the mean active flexion improved to 120º (maximum, 145º; median, 125º) from 111º. Both AKS and HSS scores improved significantly (p<0.001, paired t-test, Table 1). By using the modified Merle d’Aubigne classification, the AKS and HSS scores were categorised with respect to the patient’s co-morbidities (Table 1). Functional limitation was mainly due to medical conditions or arthritis (affecting the contralateral knee). One knee had progressive radiolucency.

There were 28 anterior soft tissue impingements, 9 being in the first year of the study. Thereafter, the anterior lip of the bearing was modified and any offending osteophytes, soft tissue, or fat pads were excised. Of the 39 (10%) knees that underwent re-operation (16 were due to anterior soft tissue impingements), 20 (5%) did not require change of the AP glide bearing and the remaining 19 were converted to a rotating platform bearing (Table 2). No patellar baja was noted after fat pad excision. No patient had catastrophic wear or failure of the polyethylene bearing. The survival rate of the AP glide bearing was 95%.

DISCUSSION

The aim of a TKA design is to restore function and normal knee kinematics so as to minimise the risk of implant failure, particularly in younger patients who are subject to higher revision rates. Mobile bearings are superior to fixed bearings because of the reduced shear stress within the polyethylene and improved wear properties. The LCS rotating platform mobile-bearing knee gives excellent clinical results. It decouples knee motion into a more unidirectional motion, thus reducing volumetric wear of the ultra high-molecular-weight polyethylene.

Kinematic studies of the AP glide bearing in cadavers, computer-automated model fitting techniques, and in vivo fluoroscopic analysis have all demonstrated both AP translation (via the control arm) and rotational movement (via the cone-shaped tibial insert), so long as the soft tissues are balanced appropriately. The LCS AP glide prosthesis is rotationally unconstrained, enabling condylar lift-off in the frontal plane without sacrificing articular conformity or developing edge loading. It accommodates screw-home rotation and achieves greater range of flexion than does the rotating platform, but others report no significant difference.

Clinical outcomes of the LCS mobile bearing knee prosthesis are excellent. The potential for wear may be higher under the multidirectional motion of the unconstrained AP glide bearing than under the decoupled unidirectional motion of the rotating platform bearing. Nonetheless, our study showed comparable results with respect to polyethylene wear, aseptic loosening, and periprosthetic osteolysis. All of which were consistent with the Joint Registry data and another study.

The surgical technique for a mobile bearing
prosthesis is more demanding (than that for a fixed bearing) and emphasises optimal alignment and ligamentous stability so as to minimise the risk of femorotibial malalignment, ligamentous instability, and even mobile-bearing failure.

The LCS AP glide is a PCL-retaining bearing and is not recommended for PCL deficient knees, owing to the risk of anterior impingement. Soft tissue impingement has been noted in early clinical reports of the AP glide. The number of impingements decreased thereafter, owing to routine excision of the fat pad and modifications to the bearing design with a more rounded anterior lip.

Patellar resurfacing is not necessary when using the LCS mobile bearing knee. The early-to-mid-term outcomes of using the LCS AP glide TKA are promising. Patellofemoral pain and other complications (including infection, osteolysis and aseptic loosening) are rare. It enables an excellent range of knee motion and functional outcomes.

REFERENCES