CLINICAL ARTICLE

Medium-Term Clinical Results of High-Flexion Knee Prostheses in Patients with Rheumatoid Arthritis

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Objective: This study was performed to evaluate the function and satisfaction outcome of patients with rheumatoid arthritis (RA) who underwent total knee arthroplasty (TKA) with high-flexion prostheses.

Materials and methods: Twenty-two patients (35 knees) using high-flexion prostheses (Zimmer, Warsaw, IN) were followed up for a period of 7–11 years from February 2007 to December 2009. Clinical and radiographic follow-up was performed using Hospital for Special Surgery (HSS), Short-Form 36 scores (SF-36), American Knee Society score (KSS), and Knee Society Total Knee Arthroplasty Roentgenographic Evaluation and Scoring System. Patient satisfaction assessments took place at the final follow-up sessions using the Marsh Satisfaction Questionnaire.

Results: The average ROM improved from preoperative 68.43° ± 33.78° to 95.54° ± 7.03° at the final follow-up. The HSS score and KSS score for pain improved from (46.49 ± 12.73) points to (85.46 ± 3.90) points and from 20.57 ± 5.91 points to 47.43 ± 3.51 points at the follow-up evaluation, respectively. Physical Component Summary (PCS) and Physical Component Summary (MCS) scores were 45.38 and 52.56, respectively by the end of follow-up. Deep venous thrombosis developed in one patient and one patient required surgical revision due to infection. There were no instances of prosthetic loosening. The satisfaction rate of patients was 95.5%.

Conclusion: Although this particular model of TKA did not yield high-flexion angles (ie, 140°) required for kneeling, squatting, or rising from the floor, significant clinical and radiographic gains were evident in these patients with RA.

Key words: Arthroplasty; Clinical result; High-flexion prostheses; Knee; Range of motion; Rheumatoid arthritis; Satisfaction

Introduction

Total knee arthroplasty (TKA) is an important procedure that provide good pain relief and funcional improvement or recovery in patients with rheumatoid arthritis (RA). Although postoperative range of motion (ROM) is a critical outcome measure in this setting, there are many influential factors. The chief predictor seems to be preoperative ROM[1,2].

In our daily lives, we need high flexion including squatting, sitting cross-legged, and kneeling. These activities require up to 165° of flexion and may have particular importance in some non-Western countries[3]. While activities such as sitting in a sofa or chairs and stepping in or out of a bathtub require between 90° and 135° of flexion[4], we often need flexion up to 140° for activities performed in a kneeling or

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squatting position and getting up from the floor[5]. Recently, a component design has been considered to improve the kinematics at high-flexion angles[6]. The high-flexion prostheses have increased offsets at posterior femoral condyles, with continued radial curvatures, thus facilitating femoral rollback and prosterior posterior femoral translation[7–9]. The present study was performed to evaluate the 7–11 year results of high-flexion knee prostheses after TKA in patients with RA. The purpose of this study was to determine whether high flexion knee prostheses help RA patients to improve their ROM and satisfaction after TKA.

Materials and Methods

This study was carried out according to the Declaration of Helsinki and the Institutional Review Board at our institution approved the study protocol. Clinical follow up was made in 25 patients (39 knees) with RA who underwent NexGen LPS-Flex Total Knee Prosthesis (Zimmer, Warsaw, IN) between February 2007 and December 2009. All TKAs were performed by a single surgeon (5 men, 8 knees; 20 women, 31 knees). Mean patient age at time of surgery was 57.52 ± 1.08 years (range, 24–76 years). The mean patient body mass index (kg/m2) was 22.40 ± 3.167 (range, 16.50–28.10). Fourteen participants had bilateral involvement.

Twenty-five patients fulfilled the diagnostic criteria of the American College of Rheumatology (ACR)[10]. The mean duration was 8.96 ± 1.89 years (range, 7–11 years). All patients preoperatively had weight-bearing anteroposterior and lateral radiographs and skyline views of patellar.

All the participants underwent TKA with the medial parapatellar approach (MPa). Synovium existing to the suprapatellar pouch, bilateral gutter, and posterior capsule were resected as much as possible. Resection were performed using an intramedullary guide on femur and extramedullary on tibial, respectively. Prophylactic Antibiotics and low-molecular-weight heparin administration served to prevent infection and deep vein thrombosis. The operative procedure was performed with a tourniquet. All patients' posterior cruciate ligament was sacrificed. No patients' patellar was resurfaced. Postoperatively, the patients received physiotherapy until they achieved straight leg raise and flexion to 90° before discharge. All participants were followed up at 4 weeks, 3 months, and 1 year, then annually thereafter.

Outcome Measurements

Function of Knee

Function of knee was assessed postoperatively by the senior author and one of the other authors using the Hospital for Special Surgery (HSS)[11] score and American Knee society score (KSS)[12] for patients who underwent TKA. The function, according to KSS, was divided into four levels: excellent (≥85 points), good (70–84 points), acceptable (60–69 points), and poor (<60 points).

Quality of Life

Quality of life was assessed with the Short-Form 36 Health Survey (SF-36)[13]. The SF-36 scale included a physical component summary (PCS) and a mental component summary (MCS). These scales were assessed before the operation and at every follow-up session.

Satisfaction

The satisfaction of patients was measured at the last follow-up and used the standard of Marsh[14]. The satisfaction was divided into six levels: extremely satisfied, very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied, and very dissatisfied.

Radiological Analysis (X-rays)

The scores during the last visit with research authors were taken as the final outcome score. Weight-bearing anteroposterior and lateral view of knees were evaluated for loosing, radiolucent line, and component positioning according to the Knee Society Roentgenographic Evaluation System[12]. The femora-tibial angle (FTA) of the knee was evaluated on anteroposterior weight-bearing radiographs.

Psychological Status

The patients' psychological statuses were evaluated by using self-rating anxiety scale (SAS) and self-rating depression scale (SDS). To investigate the effects of psychological factors on postoperative function, improvement of pain, and satisfaction rate after TKA operation.

Delayed Wound Healing, Deep Venous Thrombosis, and Infection Recurrence

Postoperative complications, namely dislocation of the surgery joint, delayed wound healing, infection recurrence, deep venous thrombosis and severe or deadly complications, were recorded.

Statistical Analysis

Statistical analysis was performed by paired, Wilcoxon signed-rank test and Fisher's exact method for evaluation of the preoperative and postoperative clinical knee scores. Probability values less than 0.05 were considered significant. Statistical analysis was performed with the use of SPSS statistics software version 16.0 (IBM, Armonk, NY, USA).

Results

Patients

All TKAs were performed by a single surgeon on 25 patients. Eight knees in five men and 31 knees in 20 women were included in this study. At the final review, one patient (one knee) was lost, and one patient (two knees) had died because of an unrelated disease. One patient (one knee) was revised.

Follow-Up

Twenty-two patients (35 knees) obtained an average follow-up of 8.96 years (from 7 to 11 years). Twenty patients (32 knees) returned to the office for evaluation. Two patients (three knees) were evaluated by telephone interview for pain, function, and SF-36.

Clinical Results

Function of Knee and Quality of Life

The mean value of the scores according to HSS was improved from preoperative (46.49 ± 12.73) points (range, 0–50 points) to (85.46 ± 3.90) points (range, 74.88–97.00 points) at the last follow-up ($P < 0.05$, by Wilcoxon signed rank test).

Average PCS scores of SF-36 improved from a mean of 26.97 points preoperatively to 45.38 points at the follow-up evaluation ($Z = -4.075$, $P = 0.000$, by Wilcoxon signed rank test). MCS scores of SF-36 were average improved from preoperative 41.85 points to 52.56 points at the follow-up evaluation ($Z = -4.107$, $P = 0.000$, by Wilcoxon signed rank test). (Fig. 1, Table 1).

Before surgery, 33 (94%) of the 35 knees had moderate or severe pain on weight-bearing. At the latest follow-up evaluation, moderate or severe pain was not informed in any knee ($P < 0.05$, by Fisher's exact method), and no pain was informed in 21 knees (60%) of the 35 knees. The mean KSS score for pain improved from the preoperative 20.57 ± 5.91 points to 47.43 ± 3.51 points at the follow-up evaluation ($Z = 17.16$, $P = 0.00$, by Wilcoxon signed rank test).

The mean preoperative ROM of knees was 68.43° ± 33.78° (range, 0°–135°). The ROM increased to 95.54° ± 7.03° (range, 85°–120°) post-operation with a mean increase of 27.11° (range, −45°–95°), with a statistical significance $Z = 2.59$, $P = 0.00$ (by Wilcoxon signed rank test). (Figs 2–5) The average ROM at 5 years after surgery was 108.55° ± 20.46°(89°–125°). While, the average ROM was 95.54° ± 7.03° (range, 85°–120°) at the last follow up, with no statistical significance ($Z = 0.25$, $P > 0.05$).

Flexion contracture of more than 10° was detected in 21 knees (17 patients) preoperatively and one knee (one patient) postoperatively. Flexion of less than 70° was detected in seven knees before surgery and in zero knees at follow-up evaluation.

Preoperatively, none of the patients can walk more than 5000 m. Three patients could not walk, and 13 patients could walk indoors. At the final evaluation, 11 patients could walk unlimited distances, nine patients could walk more than 5000 m. Preoperatively, four patients (five knees) used a walking aid, 15 patients (24 knees) did not use a walking aid, and three patients (six knees) used a wheelchair. However, one patient (one knee) used a walking aid, and zero patients (zero knees) used a wheelchair at the final review ($\chi 2 = 10.39$, $P = 0.006$, by chi-Square test) (Table 2).

Radiological Analysis

The overall mean femoral-tibial angle (FTA) of the knee was 173.80° ± 10.09° on the preoperative anteroposterior X-ray. The overall mean FTA was 174.47° ± 3.55° on the postoperative anteroposterior radiographs (Table 1). Preoperatively, eight knees had more than 180° of varus angulation (range, 3°–15°). Postoperatively, the alignment had been corrected to a mean femorotibial angle of 175.63° ± 4.44°.

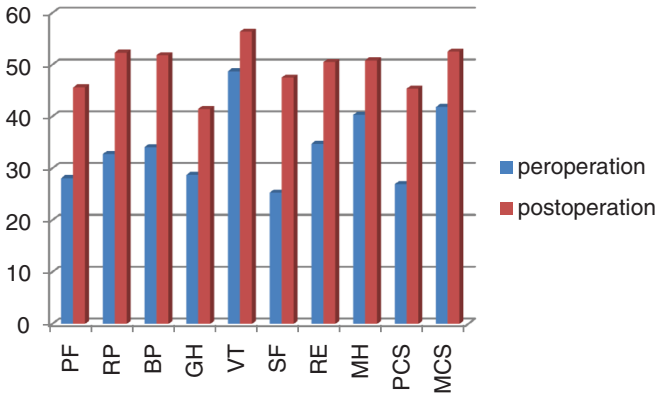

Fig. 1 SF-36 scores for 22 patients with RA at follow-up were compared. PF = physical functioning, Z = –3.979, $P = 0.000$; RP = growth physical, Z = –3.981, $P = 0.000$; BP = bodily pain, Z = –4.025, $P = 0.000$; GH = global health, Z = -3.862, $P = 0.000$; VT = vitality, Z = –3.707, $P = 0.000$; SF = social functioning, Z = –4.139, $P = 0.000$; RE = role emotional, Z = –3.903, $P = 0.000$; MH = mental health, Z = –4.023, $P = 0.000$; PCS = physical component summary score, Z = –4.075, $P = 0.000$; MCS = mental component summary score, Z = –4.107, $P = 0.000$

TABLE 1 Preoperative and postoperative clinical result data of patients of RA

	Preoperative	postoperative
Flexion angle (°)	81.71° ± 30.02°	96.69° ± 7.03°
Extension angle (°)	13.29° ± 13.28°	1.14° ± 2.45°
HSS score	46.49 ± 12.73	85.46 ± 3.90
Pain of KSS score	20.57 ± 5.91	47.43 ± 3.51
Function of KSS score	16.43 ± 15.88	71.43 ± 13.75
FTA (°)	173.80 ± 10.09	174.47 ± 3.55
ROM	68.43 ± 33.78	95.54 ± 7.03
PCS	26.97 ± 3.61	45.38 ± 8.07
MCS	41.85 ± 5.27	52.56 ± 7.13
PF	28.12 ± 6.39	45.62 ± 8.00
RP	32.78 ± 3.99	52.35 ± 9.91
BP	34.11 ± 5.33	51.84 ± 7.90
GH	28.74 ± 4.68	41.48 ± 11.31
VT	48.75 ± 5.34	56.38 ± 5.93
SF	25.33 ± 3.03	47.52 ± 7.65
RE	34.75 ± 7.62	50.52 ± 10.64
MH	40.32 ± 4.19	50.86 ± 5.69
α	–	97.83 ± 3.18
β	–	88.88 ± 3.00
γ	–	8.42 ± 5.47
δ	–	83.50 ± 6.64

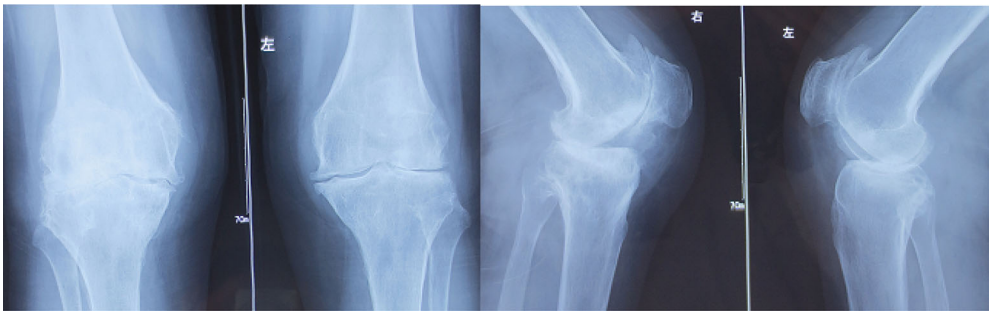

Fig. 2 The view of preoperative

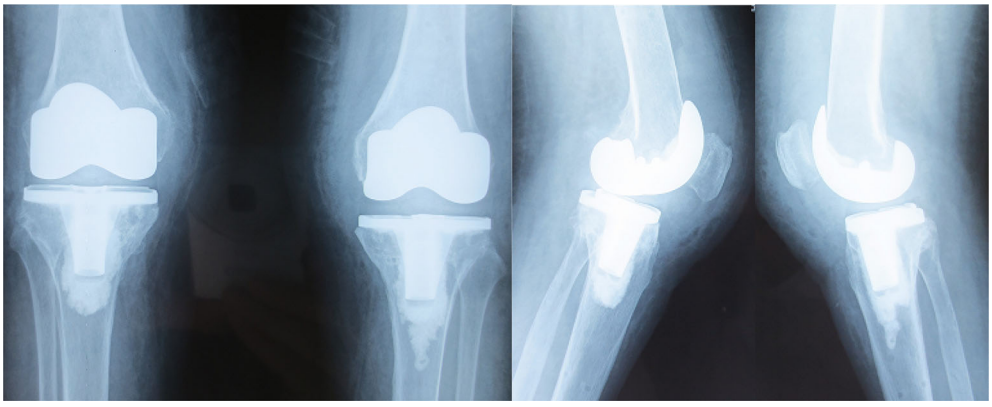

Fig. 3 The view of postoperative

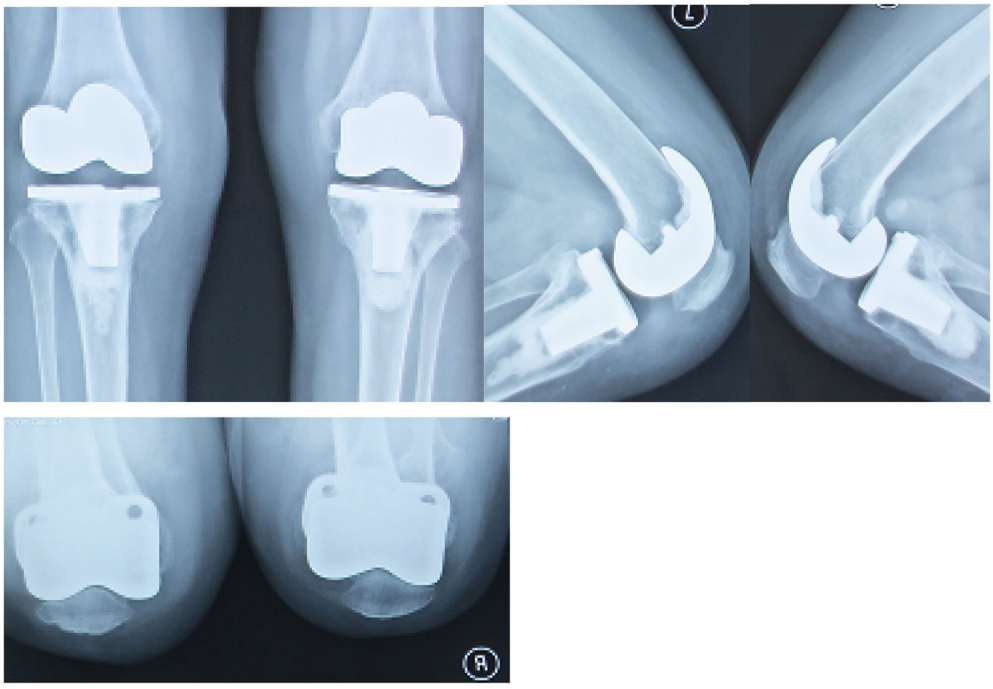

Fig. 4 The view of the patient with RA who underwent TKA after 8 years at the last follow-up

Preoperatively, 13 patients were in varus alignment and six patients were in valgus alignment. At the latest follow-up, no lucency can be seen in tibial or femoral bone–cement interfaces according to the Knee Society Scoring Method[12].

Satisfaction

Postoperative satisfaction was 94.3% (33 knees) for pain relief and 82.9% (29 knees) for function. The satisfaction of patients was measured at the last follow-up and used the

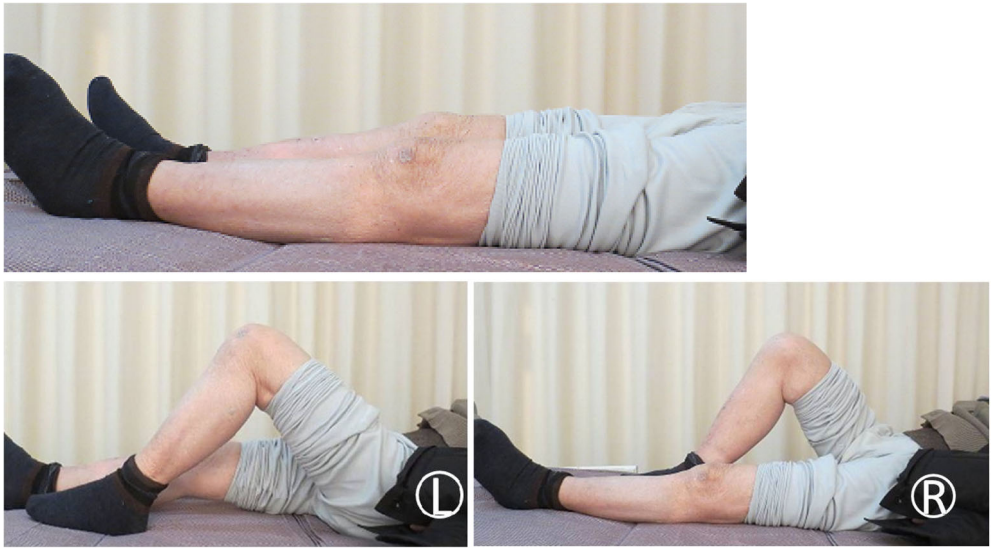

Fig. 5 The functional position view of the patient with RA who underwent TKA after 8 years at the last follow-up

TABLE 2 Comparison of use of aids between preoperative and the last postoperative follow-up

	Need a Walking aid	Can Walk	Use a Wheelchair
Preoperative	5 (14.3%)	24 (68.6%)	6 (17.1%)
Postoperative	1 (2.9%)	34 (97.1%)	0 (0.0%)
Total no.	6 (8.6%)	58 (82.9%)	6 (8.6%)

$\chi^2 = 10.39$, $P = 0.006$, $P < 0.01$.

standard of Marsh: eight patients felt extremely satisfied, 11 patients felt very satisfied, two patients felt somewhat satisfied, one felt neither satisfied nor dissatisfied. The satisfaction rate was 95.5%.

Psychological Status

The mean value of the scores according to SAS decreased from preoperative 55.94 ± 4.27 to 39.14 ± 5.05 at the last follow-up (t = 18.55, P<0.01). The mean value of the scores according to SDS decreased from preoperative 55.20 ± 6.87 to 43.36 ± 6.41 at the follow-up (t = 12.05, P<0.01). When comparing patients with and without preoperative depressive tendencies, excellent or good results rate of knee function, pain relief, and self-rate satisfaction were fewer in the depressive group.

Complications

One patient (one knee) with diabetes mellitus as underlying disease complained of heat sensation 1.5 years after TKA. This patient was revised because of infection 1.5 years after the TKA. One patient (one knee) had deep venous thrombosis and cure after intervention therapy.

Discussion

It is generally speaking that at least 90° of knee flexion is important for usual daily activities[14]. However, we often need flexion up to 140° for kneeling, squatting and standing up from the floor[5]. RA patient satisfaction with TKA depends on restoration in ROM and relief pain[15–17]. In this study, postoperative ROM of the RA patients is 95.54° ± 7.03°, which is much lower than 140° for high-flexion activities, but most patients do not consider these activities to be more important than pain relief and the ability to do their daily activities. In our cases, 21 knees had no pain. In the no pain group, FTA was 174.61° ± 2.38°. Fourteen knees with a low pain score had malalignment or malpositioning of the component[18]. However, no significant difference in FTA was found between the knees with pain and knees with painlessness group. The result of maximum flexion at the latest follow-up was also lower than that reported[19–21]. The functional status of rheumatoid patients after TKA is much lower than that of osteoarthritis[22]. It might be due to the polyarticular nature of RA.

Postoperative satisfaction was 94.3% (33 knees) for pain relief and 82.9% (29 knees) for function. The percentage of function is lower than pain relief because of the polyarticular nature in RA. The sum satisfaction rate of 95.5% was measured according to the standard of Marsh. Average PCS scores and MCS scores improved post-operation, which means the patients' health statuses improved.

The use of a tourniquet can not only decrease intraoperative blood loss but also create a bloodless surgical field, which theoretically could facilitate the cementing technique and other surgical procedures[23–25]. According to these benefits of the tourniquet, we used tourniquets for all TKAs in our study. But some studies have reported that the use of a tourniquet could not help to reduce intraoperative blood loss[24, 26, 27], which might increase the risk of venous thrombosis[28]. At the final review, only one patient (one knee) had

deep venous thrombosis and a cure after intervention therapy. It is still being debated whether a tourniquet can be used to reduce blood loss in TKA. Some studies[23–25] reported that a tourniquet is positive to reduce blood loss. But the others showed the opposite[27, 29, 30]. A meta-analysis[16] reported that the intraoperative and total blood loss was significantly less in tourniquet groups. At the same time, one study reported that the use of tourniquet during TKA was effective for reducing blood loss, avoiding excessive postoperative inflammation and muscle damage[31]. We used tourniquets precisely for these reasons, intending to counter the risk of venous thrombosis through appropriate means.

Periprosthetic joint infection is one of the most devastating complications after TKA. In our study, one patient (one knee, 2.56%) was revised because of infection 1.5 years after the TKA. In the 7–11 year follow-up study, there was only a 2% prevalence of infection[32]. During the first 3 years post-arthroplasty, Tayot *et al.* reported[33] that five patients with RA suffered infection. This is because RA patients are commonly administrated immunosuppressive and steroid medications.

We could not find a single case of aseptic loosening in our series. There was no evidence of loosening, which was found in the interface between bone and prosthesis. However, Han *et al.*[34] reported which aseptic loosening of the femoral component occurred in 27 knees (38%) following high-flexion prosthesis at the follow-up from 30–48 months. In the loosened group of this study, 85% of patients' knees could allow for sitting cross-legged, kneeling, and squatting. Cho *et al.*[35] reported that the patients with the mean ROM of 142° showed progressive radiolucent lines. However, most of the patients in our study had a much lower mean ROM of 95.54°[34, 35]. There was no evidence of loosening in our patients, which may be due to the low ROM in their daily lives.

The goal of this study was to analyze the middle-term results of RA patients who receiced high-flex posterior stabilized TKA. Although the radiological results and satisfactory clinical pain relief of this study 7–11 years after operation support the use of high-flexion prosthesis in patients with RA, it does not achieve postoperative high flexion, which is used in patients with RA. Depression may also detract from surgical results, undermining patient satisfaction levels, so needed counseling or treatment must not be overlooked.

Limitations of the Study

This study had some limitations. First, this was a retrospective study. Second, the sample size was small. Third, the follow-up period was short. We will continue this study using a larger sample size and longer follow-up time in order to make our study more meaningful.

Acknowledgements

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