OPEN ACCESS

Journal of Orthopedic Research and Therapy

Garcia JJE, et al. J Orthop Res Ther 9: 1365.

www.doi.org/10.29011/2575-8241.001365

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Research Article

Total Knee Arthroplasty in Patients Under 50 Years of Age: Complications, Functional Results, And Survival. 20 Years Follow-Up

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Citation: Garcia JJE, Romera CHH, Maldonado RAM, Borjon ED, Barba LDM, et al. (2024) Total Knee Arthroplasty in Patients Under 50 Years of Age: Complications, Functional Results, And Survival. 20 Years Follow-Up. J Orthop Res Ther 9: 1365. https://doi.org/10.29011/2575-8241.001365

Received Date: 22 October, 2024; **Accepted Date:** 30 October, 2024; **Published Date:** 04 November, 2024

Abstract

Introduction: Total knee arthroplasty (TKA) is an accepted treatment option to improve joint function in young patients with degenerative diseases. The objective of this study was to evaluate the complications, functionality, and survival of TKA in patients under 50 years of age due to the limited reports in the literature on this topic. **Material and Methods:** A retrospective cohort study was conducted at the "Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán" in México from 2000 to 2020, with a 95% confidence interval (CI). One hundred eighteen patients were evaluated, of whom 73.1% underwent a procedure on one knee and 26.9% on both knees. Complications, functionality, and implant survival were assessed in young patients following total knee arthroplasty (TKA). Functional outcomes were evaluated using the Knee Society Score (KSS), Oxford Knee Score (OKS), and Western Ontario McMaster Universities Osteoarthritis Index (WOMAC). Statistical analysis was performed using STATA version 15 for MacBook. **Results:** Patients with inflammatory rheumatic diseases were the primary group that underwent TKA procedures. With an average follow-up of 10.2 years, the survival rate was reported to be 95% at five years (95% CI, 0.029-0.065) and decreased to 88.1% at 12 years (95% CI, 0.050-0.081). **Conclusions:** Total knee arthroplasty in young patients offers long-term functional and satisfactory results. TKA survival in our population is excellent at ten years but tends to decline after 15 years.

Keywords: Arthroplasty; Knee, Young; Complications; Function; Survival.

Introduction

TKA is considered an optimal surgical intervention to improve mobility and pain in patients with osteoarthritis and other articular cartilage diseases [1]. In young patients, joint damage occurs at an accelerated rate, requiring medical treatment earlier, as the quality of life must be considered in daily activities [2-4]. This study aimed to evaluate the complications, functionality, and survival of TKA performed in patients under 50 years of age.

Material and Methods

This retrospective cohort study included patients aged 50 years or younger who underwent TKA surgery between 2000 and 2020 at the "Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubiran", in Mexico. We included patients from the Hip and Knee Reconstruction Service who underwent surgery in our medical unit, had data available in their medical records, and gave consent to participate in the study. We collected socio-demographic characteristics, comorbidities, functionality, complications, and TKA survival information. Functional scales were used to assess these: Knee Society (KSS), Oxford Knee Scale (OKS), and the Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) questionnaire.

Statistical analysis was performed using STATA version 15 for MacBook. Continuous variables were presented as means and standard deviations, and categorical variables as frequencies and percentages. Differences between groups were assessed by chi-squared test (x^2) for categorical variables and Student's t-test for continuous variables. Survival was estimated using the Kaplan-Meier method. The survival analysis results were presented with a 95% confidence interval (CI). A value of $P<0.05$ was considered to be statistically significant.

Results

Characteristics and Complications

Our study evaluated 118 knees, with 73.1% of patients undergoing TKA on one knee and 26.9% undergoing TKA on both knees. The mean age was 39.9 years, and the mean follow-up was 10.2 years. We observed that 85.6% of the patients were female and 30.3% were male. The mean age was 40 years, and the mean body mass index (BMI) was 27.8. Sixteen TKA procedures failed, with a mean follow-up of 10.2 years.

Regarding comorbidities, as we can see in Table 1, rheumatoid arthritis (RA) was the most common comorbidity with 88.9%, followed by systemic lupus erythematosus (SLE) with 7.6%. The prevalence of other comorbidities was very low. Patients with rheumatic diseases treated with steroids were also reported, with avascular necrosis (AVN) of the femoral head in 3.4% and other diseases such as chronic kidney disease and hypothyroidism were reported in 1.7% each.

The most frequent complications were periprosthetic infection (7.6%) and aseptic loosening (5.9%). Regarding the rest of the possible complications, the frequency was relatively low. On another note, 8.5% of the cases requested TKA revision surgeries due to complications that arose with greater frequency. The main complications for this age group were periprosthetic infections: 83% of them occurred in patients under 40 years of age. Arthrofibrosis developed as well. It was observed that patients at the time of the TKA had a decreased risk of arthrofibrosis (P=0,045).

Comorbidities	Frequency
Rheumatoid arthritis	88.90%
Femoral avascular necrosis	3.40%
Ankylosing spondylitis	1.70%
Systemic lupus erythematosus	7.60%
Chronic kidney disease	1.70%
Hypothyroidism	1.70%

Table 1: Comorbidities of patients under 50 years of age undergoing TKA.

Prevalence of patients with inflammatory rheumatic diseases in our study. A total of 118 patients were part of this study. The most common complications were periprosthetic infection (7.6%) and aseptic loosening (5.9%). The incidence of other complications was relatively low. On the other hand, revision surgery was reported in 8.5% due to the most common complications. The main complications in this age group were related to periprosthetic infections, which occurred in 83% of patients under 40 years of age, and the development of arthrofibrosis. It was observed that people who underwent TKA had a lower risk of developing arthrofibrosis (P=0.045). Frequency of complications. A total of 118 patients were part of this study (Table 2).

Complications	Frequency
Aseptic loosening	5.90%
Periprosthetic infection	7.60%
Arthrofibrosis	1.70%
Posterior instability	0.90%
Medial instability	1.70%
Tendonitis	0.90%
Periprosthetic fracture	1.70%
Peroneal nerve injury	1.70%
Revision Surgery	8.50%

Table 2: Complications in patients younger than 50 years who underwent TKA.

Assessment of functionality

On the KSS Functionality Scale, a score of 85-100 points indicates an excellent result, a score of 70-84 points indicates a good result, a score of 60-69 points indicates a fair result, and a score below 60 points indicates a poor functional result. When assessing functionality using the KSS questionnaire, we observed that the highest proportion of patients scored between 70 and 79 points. For the OKS scale, the following scoring parameters were defined: a score of 40 to 48 points indicates an excellent outcome, as the patient has little limitation in performing daily activities; a score of 30 to 39 points indicates a good outcome, as the patient may have limitations; a score of 20 to 29 points indicates a moderate outcome, as there are varying degrees of pain and functional limitations; finally, a score of less than 20 points indicates a poor result, as the pain is severe and the knee function is severely impaired. Patients' pain intensity, stiffness, and functionality were assessed for the WOMAC functional assessment, with scores close to 0 indicating adequate function and high scores indicating poor function. In the OKS questionnaire, the majority scored between 34 and 41 points, while in the WOMAC questionnaire, the mean score was 13, with a range of 8 to 67 points. Relation between scales of functionality and frequency of presentation (Table 3).

Functional assessment scales	Scores	Frequency
KSS	80 – 100	22.90%
	70 – 79	39.90%
	69 – 60	13.60%
	<60	4.20%
Oxford	>41	17.80%
	34-41	37.30%
	27-33	20.30%
	<27	5.10%

Table 3: KSS and OKS Functional assessment scales.

TKA survival

Assessing TKA survival with a median follow-up of 10.2 years, we observed 95% survival at five years (95% CI, 0.029-0.065) and 88.1% survival at 12 years (95% CI, 0.050 - 0.081). TKA survival was evaluated using the Kaplan-Meier method (Figure 1).

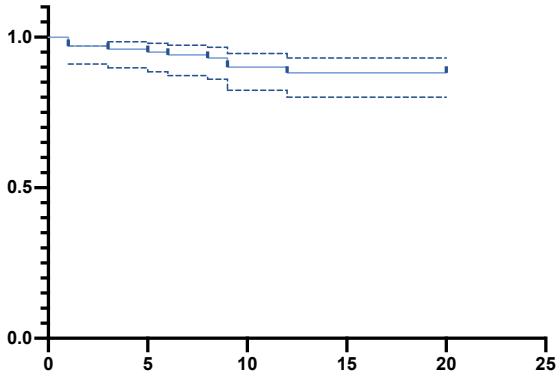

Figure 1: TKA Survival in Younger.

Discussion

Total knee arthroplasty (TKA) is an effective treatment for advanced knee pathology. It is one of the most popular treatments due to the results in terms of pain, mobility, functionality, and return to quality of life. Some reports in the literature have identified age and increased mobility as risk factors for survival of less than ten years, as well as high surgical revision rates [2,5-7]. The main risk factors that may increase TKA failure are patient comorbidities, mainly obesity. According to a study conducted in Chicago, patients aged <65 years undergoing TKA had a higher BMI than patients aged 65 years or older. This may explain the incidence of periprosthetic infection and aseptic loosening in younger patients. However, our patients' BMI was not as high, and we mainly observed overweight [8-10].

In patients with ankylosing spondylitis (AS), the hypothesis of knee inflammation or mechanical stress associated with hip joint damage has been commented on, according to Ward et al. [11], in which they conducted a study related to THA. In our patients undergoing TKA, we found the coexistence of hip damage or hip surgery with knee arthroplasty or degenerative joint pathology, confirming the hypothesis of hip inflammation associated with knee pathology [11]. John R. Martin et al. [12] conducted a study in Rochester, United States, in which they evaluated 19 patients and reported 29 knees that required TKA. The mean age was 18 years, and the follow-up was 14.5 years. This study reported cases of juvenile idiopathic arthritis (JIA), AVN of the femoral head,

sepsis, trauma, dysplasia, and haemophilia [12]. Our population found patients with inflammatory rheumatic diseases such as RA. This percentage includes patients with a diagnosis of JIA and RA, reaching 88.9%. In a smaller proportion, AS was reported in 1.7% of cases. There are few reports on inflammatory rheumatic diseases and the use of arthroplasty. The percentage of young patients undergoing arthroplasty for degenerative or traumatic pathology is higher, according to a report by Victoria E. Bergstein et al. In 2023, they conducted a study that reported on young patients undergoing TKA whose primary diagnosis was unrelated to inflammatory rheumatological diseases. They found that after 40 years, the survival rate of TKA was 65.3%, and mobility improved, allowing patients to perform heavy work and some sports [13].

There is a trend towards performing THA and TKA in younger patients, driven partly by demand from younger patients. By 2030, 52% of primary THA and 55% of TKA are expected to be implanted in patients younger than 65 years [9]. Cemented TKA is the gold standard due to better outcomes and implant survival of up to 20 years. However, younger patients have a higher implant loading requirement, so cementless TKA is relevant in younger patients, as reported by Chengyu Chen et al. in 2019 [14]. All patients in our study underwent cemented TKA [15,16].

In the United States, a study of TKA in patients younger than 50 years was conducted in 2019, with a follow-up of 13 years. Nine patients underwent revision surgery due to aseptic loosening (3.6%), periprosthetic joint infection (PJI) (3.2%), and polyethylene wear in TKA (2.8%). TKA failure's causes were tibial fixation, infection, varus augmentation, and tibial slope problems. In our study, the main complications were PJI (7.6%), aseptic loosening (5.9%), and arthrofibrosis (1.7%), with comparable results [17].

In 2016, the Mayo Clinic in Rochester, US, reported that the leading causes of revision surgery in adolescents were aseptic loosening, polyethylene wear, and PJI. Radiographs showed changes related to polyethylene wear in 9% and osteolysis in 13%. In addition, 44% of patients had complications, the most common being stiffness and development of arthrofibrosis [12]. In our study, we observed a low incidence of stiffness and arthrofibrosis.

In a review of 349 TKA procedures in 2013, in patients younger than 60 years with a diagnosis of JIA, a mean age of 28 years was reported; the main complications observed were polyethylene wear, aseptic loosening, and osteolysis in 18 patients. Thirty-one out of 349 patients required revision surgery. The survival of TKA at ten years was 95%, and at 20 years, they also reported polyethylene wear, loosening, and osteolysis as the main reasons for revision [18]. Therefore, aseptic loosening is one of the major complications in young patients; in our study, aseptic loosening was reported to be 5.9%.

TKA is the treatment for symptomatic knee osteoarthritis; however, these procedures are not without complications that may affect mobility and function and require revision surgery. As observed in our population, the most common complications reported in the literature are PJI and aseptic loosening, the most common diagnoses requiring revision surgery. The results are similar to those reported in the literature.

In 2014, a study was conducted in the United States on 114 patients with a follow-up of 25 years, aiming to evaluate young patients and observe a TKA survival rate of 70% at 30 years. Aseptic loosening was the most common cause of failure and revision surgery. Long et al. reported an improvement in the KSS Functional Scale and Tegner and Lysholm Activity Score [19]. Our study reported improved functionality using the KSS, Oxford, and WOMAC scales. On the KSS scale, 22.9% of patients scored 80-100 points, and 39.9% scored 70-79 points. For the Oxford scale, 17.8% scored >41 points, 37.3% scored 34-41 points, 20.3% scored 27-33 points, and 5.1% scored <27 points.

Patients younger than 55 years have reported improvements in quality of life after TKA, but despite their return to activity, adequate postoperative care, postoperative education, and knowledge of revision surgery must be performed at some point [20-22].

Due to the increasing number of procedures performed on young patients, there has been a push for developing and using more wear-resistant surfaces that may reduce the risk of revision and TKA failure in young patients [17]. In a study comparing TKA wear surfaces in young patients under the age of 55, no differences were found in the KSS and WOMAC functional scales or in radiographic measures of complications, wear, and survival [23]. A systematic review and meta-analysis in 2015 reported that the quality of life of patients undergoing TKA was significantly improved compared to preoperative levels. However, these patients had a diagnosis of osteoarthritis [24]. As for our patients, most of them were satisfied with the surgery and obtained significant benefits in performing functional activities of daily living, reducing pain, and increasing mobility. In the present study, the values for the whole population were satisfactory, except for patients with complications.

In 2016, Rochester (USA) reported a 5-year TKA survival of 96% and a 10-year survival of 94% [12]. In 2014, a study of patients with osteoarthritis reported a 30-year survival of 70%, with aseptic loosening being the most common cause of TKA failure and revision [19]. Thomas J. Heyse et al. reported a survival rate of 92% at 13 years in a study with a 13-year follow-up [17]. In 2013, a study with a 10-year follow-up reported 95% survival at ten years and 81.6% at 20 years [18]. In 2022, the New York University reported 98.7% and 98.6% survival at 5 and 8 years, respectively,

in a study of patients aged 18 to 65 years. They also reported the following complications: periprosthetic infection (15%), aseptic loosening (14%), and instability (23%). Young-Hoo Kim et al. compared the survival of different friction surfaces, such as the Oxinium surface versus the Cobalt Chromium (CrCo) surface, in patients under 55 years of age diagnosed with severe osteoarthritis and reported 97% survival in patients with Oxinium prostheses and 98% survival in patients with CrCo prostheses after 13 years of follow-up [23]. In our study, we observed a lower survival rate: at five years, the survival rate was 95% (95% CI 0.029-0.065), and at 12 years, it decreased to 88.1% (95% CI 0.050-0.081). All of our patients have undergone a TKA with CrCo materials.

In 2010, Lund University Hospital in Sweden studied patients under 55 diagnosed with osteoarthritis, comparing procedures such as TKA, unicompartmental prostheses, and tibial osteotomies. It was concluded that TKA was the best treatment option compared to the above procedures due to the high cost of revision surgery and conversion to TKA. This led to a decrease in the use of this type of procedure [7]. Conversely, the 2010 study by Hassan Zmerly et al. evaluated young patients diagnosed with achondroplasia and found excellent results in young patients with severe osteoarthritis. This study used osteotomies to correct bony angular deformities [6].

It is important to note that TKA is a procedure that should be evaluated in terms of the economic costs to the hospital, in addition to the readmissions for re-intervention that may occur after a complication or revision surgery. On this basis, patellofemoral replacement has been compared with TKA in young patients, showing reduced economic costs, readmissions, and the advantage of having a bone stock option for revision surgery [25]. In the future, it would also be desirable to evaluate the development of more resistant wear surfaces [23].

Among the weaknesses of our study, it should be noted that we did not have young patients undergoing TKA with trauma or degenerative pathologies since our medical institution only accepts cases of patients with complex pathologies. In addition, we collaborate with the rheumatology service of our medical unit, whom we thank for their help. Furthermore, at the time of our study, we did not have preoperative functional scales in our medical records to compare the results.

Conclusion

Total knee arthroplasty in young patients should be performed with a precise indication because it offers satisfactory results. However, like any intervention, it is not complications-free, emphasizing the need for rigorous care. In our study, all patients who underwent arthroplasty received multidisciplinary care, with particular emphasis on the epidemiology and rheumatology services, using protocols described in the procedural guidelines of the American College of Rheumatology of the United States and the American Hip and Knee Association for the development of joint replacement procedures [26]. In our study, we observed a significant improvement in the quality of life of patients with early joint involvement who had poor mobility, low functionality, and impaired quality of life, which improved after TKA.

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