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Age predicts outcome of high-tibial osteotomy

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Abstract This study compares the predictive value of age at surgery in high tibial osteotomy. Twenty-seven high-tibial osteotomies in patients who are 65 years or older (mean age at surgery 68 ± 4 years, follow up 12 ± 2 years) were compared to 67 osteotomies in patients younger than 65 years (mean age at surgery 56 ± 6 years, follow up 13 ± 3) with respect to the outcome by Cox regression analysis. Failure, i.e. endpoint, was defined as implantation of a knee endoprosthesis and assessed by Kaplan-Meier analysis. There is a significantly higher risk for failure of high tibial osteotomies in patients of 65 years or more compared to younger patients (failure rate 38.4 ± 11.3% vs. 23.1 ± 5.8%) resulting in a relative risk of 1.5 ($P = 0.0461$). The hazard of failure increased 7.6% per year of age. We conclude that in regard to the increasing risk of failure per year of age and the higher failure rate in older patients, high-tibial osteotomy should not be performed on patients older than 65 years.

Keywords High tibial osteotomy · Survival · Age at surgery · Failure

Introduction

High-tibial osteotomy is still a standard treatment for medial unicompartimental osteoarthrosis in genu varum with satisfying results with a survival rate of over 80% after 10 years. Results success then drop continuously and the risk of failure and implantation of total knee endoprostheses increases. Risk factors for the failure of high-tibial ostetomy have been well established and include, for instance, the grade of correction, overweight, severity of preoperative arthrosis, ligament stability and axial deviation [1–15]. Although all these factors have been investigated intensively, available reports on the age of the patient at the time of surgery as a predictive factor for the outcome of high-tibial osteotomy are scanty. It is the aim of this study to analyse the influence of age at the time of surgery on the outcome by survival analysis and to estimate of the relative risk.

Materials and methods

Patients

Twenty seven high-tibial osteotomies in patients who are 65 years or older (mean age at surgery 68.4 ± 3.7 years; range 65–76 years; 21 patients) were compared to 67 osteotomies in patients younger than 65 years (mean age

at surgery 56.2 ± 6.1 years; range 42–64 years; 52 patients). Mean follow-up time was 11.9 ± 2.2 years (range 10–16) in the older group and 13 ± 2.5 years (range 8–17) in the younger patients. Mean follow up of all patients was 12.7 ± 2.4 years (range 9–17) with a mean age at surgery of 59.8 ± 7.8 years. Forty three patients were lost to follow up because of death ($n = 23$), immobility of other diseases ($n = 5$), or because they could not be reached ($n = 15$). All patients underwent surgery according to the method described by Coventry [16] by a lateral approach and removal of a lateral open wedge with overcorrection, opening of the tibio-fibular syndesmosis and fixation with staples with a screw in the distal part. Patients then received a cast for 6 (4–10) weeks. Twenty one patients had a bilateral osteotomy (15 younger and 6 older patients). The patients were examined at evaluation and the mechnical axis was measured on long standing radiographs. Evaluating the mechanical axis at follow-up revealed that 61% of the patients had a well aligned axis between 3° varus or valgus. Differences between groups did not reach statistical significance, the same is true for gender.

Statistical analysis

The risk of prosthetic failure in time after surgery was evaluated by the Kaplan-Meier analysis [17]. Failure, i.e. endpoint, is defined as implantation of a total knee endoprosthesis. In order to independently evaluate factors influencing the risk of prosthetic failure with time after surgery, the Cox regression analysis was performed with age and/or number of sides being included in the model. Patients categorized in age groups < 65 years and ≥ 65 years were compared with regard to the risk of failure by the logrank test and the relative risk was estimated by the Cox regression. A P value < 0.05 was considered statistically significant.

Results

The ten year survival rate for high-tibial osteotomy amounted to 90% in patients younger than 65 years and only 70% in older patients (Fig. 1). In the older group, 33.3% (9/27) received a total knee endoprostheis after 4.6 ± 3.3 years (range 2–12) and in the younger only 19.4% (13/67) after 9.1 ± 3.3 years (range 1–13). Age at surgery significantly influenced the risk of prosthetic failure as evaluated by the Cox regression analysis. The hazard of failure increased by 7.6% (95% confidence interval: 1.0–14.5%) per year of age (Table 1). Therefore, the risk failure was significantly higher in patients 65 years or more compared to younger patients (38.4 ± 11.3% [67 cases, 13 events] versus 23.1 ± 5.8%, $P = 0.0381$ [27 cases, 9 events], Fig. 1), giving a relative risk of 1.5480 (95% CI: 1.0077–2.3780; $P = 0.0461$) compared to younger patients. The significant association with age did not change even when considering that some of the procedures were performed on both sides

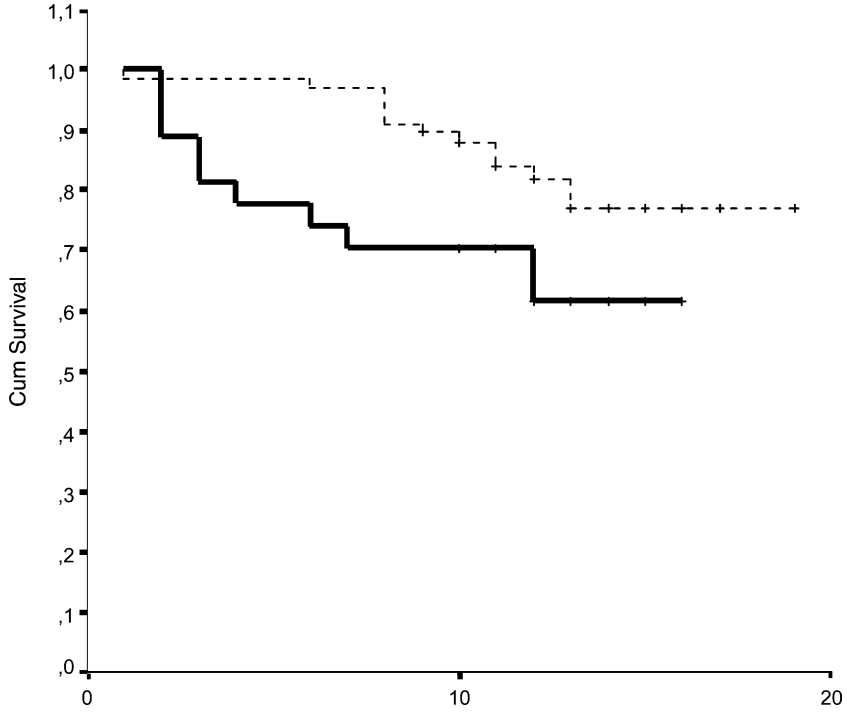

Fig. 1 Cummulative survival of high-tibial osteotomies by Kaplan-Meier-Analysis. Patients were categorized in age groups (> 65 years—*bold line*; < 65 years—*dashed line*) and compared concerning osteotomy endpoint. Older patients had a higher risk of failure ($P = 0.0461$) compared to younger

Table 1 Data showing variables, regression coefficients, exp (B), confidence intervals, p values for the models A, B and B

Model	Variable	Regr. coeff. B ± SE	Exp (B)	95% CI	*P*-value
A	Age (years)	0.0729 ± 0.0320	1.0756	1.0103–1.1451	0.0226
	Overall	0.0231			
B	Age cat. (0,1)	0.4369 ± 0.2190	1.5480	1.0077–2.3780	0.0461
	Overall	0.0397			
B	Age (years)	0.0722 ± 0.0318	1.0749	1.0098–1.1441	0.0234
	Sides (1,2)	0.1628 ± 0.4276	1.1768	0.5090–2.7207	0.7035
	Overall	0.0684			

94 cases, 22 events (= prothetic failure)
Age categories < 65 years (0) and ≥ 65 years (1); relative risk of cat. 1 compared to cat. 0

(though overall *P* of the model was only borderline significant when including both factors, Table 1). Additionally, the time point of failure was significantly earlier in the older age group ($P < 0.01$).

Discussion

This study provides a long-term follow-up for the treatment of medial gonarthrosis with high-tibial osteotomy with 13 ± 2 years (range 9–17 years) for all 94 osteotomies with a mean age at surgery of 59.8 ± 7.8 years (range 45–76 years). Due to the increasing number of uni- and bicompartmental endoprostheses with respect to a higher life expectancy, it was the aim of this study to evaluate the outcome of high-tibial osteotomy with increasing age. The two age groups were treated in the same clinic with similar procedures and investigated with respect to survival of the osteotomy, i.e. without implantation of a knee endoprosthesis. Although there are a lot of studies dealing with risk factors for high-tibial osteotomy, reports on the influence of age are scanty. It is well know from long-time studies that, for instance, the grade of correction, overweight, severity of preoperative arthrosis, ligament stability and axial deviation [1–15] are all factors. It is well known that the results deteriorate with the follow-up duration. Ten year survival rates range from 70% to 90% [3, 6, 7] with a decrease to 55–70% [3 and patients of this study] after 15 years.

The fact that the age at surgery is a risk factor for failure of high-tibial osteotomy has not been pointed out clearly so far. Two studies reported a high survival rate in patients younger than 50 years, but there is no comparison with an older group and no regression analysis [15, 18]. The results of our study indicate a significantly higher failure rate in patients over 65 years. Taking the high failure rate with the mean short time to a total knee endoprostheses, we cannot advise this treatment for older patients. In contrast, the good results for patients younger than 65 years with a 10-year survival rate of 90% strongly argues for high-tibial osteotomy in this group. An unicompartmental endoprosthesis instead of the osteotomy would not result in a longer revision free interval for the patient.. Unicompartmental endoprosthesis has a revision rate of 10–28% after 4–12 years [19–22]. On the other hand, although it is technically demanding, total knee replacements after high-tibial osteotomy do not have a worse outcome [23], which does not argue against osteotomy.

The results of this study are based on an objective endpoint, i.e. total knee arthroplasty. When patients were evaluated for subjective and functional outcome, some patients in the older group were offerred a total knee arthroplasty. Interestingly, they refused surgery on account of age and other diseases. In contrast, none of the younger patients was offered an arthroplasty at follow-up by the investigator. If the subjective factor is taken into account, the difference between the old and young is much stronger than the results presented in this paper would suggest.

We conclude that high-tibial osteotomy is a good choice for younger patients suffering medial varus gonarthrosis. Despite the increasing risk of failure per year of age and the higher failure rate in older patients, high tibial osteotomy for younger patients still has a place in the repertoire of a reconstructive knee surgeon.

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