



Complications after total knee arthroplasty A comprehensive report

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In most reports of complications following TKA, the method of assessment and report of complications is not defined specifically. It is thus unclear whether certain complications did not occur or were simply not assessed at all. A detailed list of possible complications following TKA was developed, and the occurrence of complications in 567 primary TKAs was followed up meticulously according to this list for one year postoperatively.

The proportion of knees with complications was 23.6%. A revision operation was performed in 5.6%. The most frequent complication was delayed wound healing.

Only a worldwide accepted standard list of well-defined complications will allow comparison of future studies on complications in TKA. For purposes of quality control, the amount of detail recorded must be weighed carefully against its practical value.

not occur or were not assessed. This leaves a wide space for individual interpretation and makes comparison of results difficult.

The purpose of this study was to define, assess and report all major and minor complications of primary TKA over the course of one year, in a standardised and reproducible way. Additionally, the effect of patient related criteria on the occurrence of complications was evaluated.

PATIENTS AND METHODS

From November 1997 to May 2001, 567 primary TKA's were performed in 499 patients (160 male, 339 female) at the Orthopaedic Department of the University of Mainz, Germany. The mean age of patients was 69.9 years (range, 36 to 92 years). The primary

INTRODUCTION

The rate of complications after Total Knee Arthroplasty (TKA) reported in most publications is relatively low, since only major complications leading to revision or implant exchange are reported. When a study includes minor complications such as delayed wound healing, the complication rate may rise to 10% (3). When complications are reported in detail, the rate may rise to 35% (4). It is often not clear how the reported complications were defined or whether certain complications did

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diagnosis was osteoarthritis in 518 cases (91.4%) and rheumatoid arthritis in 49 cases (8.6%).

In all cases, the P.F.C.-Sigma prosthesis (Johnson & Johnson Orthopedics) was used: cruciate-retaining in 334 TKA's (58.9%), cruciate-substituting in 222 TKA's (39.2%) and TC3 in 11 TKA's (1.9%). The patella was replaced routinely (PE oval dome) and all components were cemented with Refobacin-Palacos. A single-shot perioperative antibiotic was administered (1.5 g Cefuroxim), and low-molecular-weight heparin was administered as thromboembolic prophylaxis for at least 4 weeks after surgery.

Complications were assessed in a standardised fashion. Intraoperative complications were recorded by the operating surgeon. Complications during hospital stay were recorded by the ward physician just prior to discharge, usually between the 12th and 14th postoperative day. Patients were clinically reviewed after 6 weeks, 6 and 12 months, radiographs were obtained and further complications examined and recorded. The patient's charts and documents were checked systematically for antibiotic treatment or deviant laboratory parameters in order to make sure that no complication was overlooked.

A standard comprehensive list of 70 well-defined complications was developed based on the „Guidelines for Classification and Nomenclature of Complications“ of the Orthopaedic Department, University of Heidelberg (1). Care was taken to include all possible complications occurring after total knee arthroplasty (table I).

Complications were listed one by one, and grouped as „general“ or „knee-related“. The frequency of complications was correlated with the following patient-specific data: age, gender, body-mass index (BMI), primary diagnosis (osteoarthritis versus rheumatoid arthritis), and immunosuppression (long-term corticoids and/or immunomodulative medication).

For statistic analysis, the SPSS®-program (version 10.0 for Windows®) was used. The influence of patient-specific data on the frequency of complications was assessed with the Fischer-exact test (osteoarthritis versus rheumatoid arthritis as primary diagnosis; immunosuppressive medication versus none) or the unpaired Wilcoxon-test (age, gender, BMI). The influence of immunosuppressive medication, age and BMI was evaluated by logistic regression for both osteoarthritis and rheumatoid arthritis patients.

RESULTS

Of the 567 primary TKA's, 512 (90%) were regularly followed during the entire period of one

year postoperatively. Six patients died of causes unrelated to the knee arthroplasty in the course of the first postoperative year. Thirty six patients did not attend the regular follow-up examinations and were contacted by telephone or letter. For these patients, no further complications or re-operations were reported. Thirteen patients could not be localised or contacted for follow-up examinations.

The total number of complications (table II) was $n = 148$ (26.1%), knee-related complications $n = 89$ (15.7%) and general complications $n = 59$ (10.4%). Six patients showed multiple complications in the same knee: the number of knees with complications was $n = 134$ (23.6%) and the number of knees without any complication was $n = 433$ (76.4%). In 32 knees (5.6%) a total of 36 revision operations were performed.

Fifty patients (8.8%) were on long-term immunosuppressive medication: 2.7% of the patients with osteoarthritis (indications: chronic obstructive pulmonary disease, polymyalgia rheumatica, inflammatory diseases of the digestive tract, or alopecia totalis), and 73.5% of the patients with rheumatoid arthritis. Table III shows the frequency of complications in patients with versus without immunosuppressive therapy in relation to the primary diagnosis. Patients receiving immunosuppressive medication had twice as many complications as patients without immunosuppressive medication. This difference is statistically significant ($p < 0.015$). Patients with gonarthrosis showed slightly more complications than patients with rheumatoid arthritis, but after eliminating the influence of immunosuppression, age and BMI by multivariate analysis, the differences were statistically not significant. Neither was there a significant influence of age and BMI on the frequency of complications.

DISCUSSION

A complication rate of 23.6% after TKA appears very high; much lower rates are usually reported. It is, however, necessary to consider which complications are assessed and how they are reported.

The discussion of complications after TKA is hardly comparable between different publica-

Table I. — Comprehensive list of possible complications after knee arthroplasty. This list was used to record all complications occurring in the population studied

- delayed wound healing (without infection) with / without revision
- superficial wound infection with / without revision
- deep (intraarticular) infection with / without revision
- necrosis of skin or subcutaneous tissue with / without revision
- dehiscence of the wound with / without secondary suture
- keloid scar
- neural lesion with temporary sensory/motor loss
- neural lesion with permanent sensory/motor loss
- neural lesion requiring revision
- haematoma without further therapy
- haematoma requiring blood transfusion or antibiotic treatment
- haematoma requiring revision
- hemarthrosis or effusion with / without puncture
- seroma with conservative / operative therapy
- bursitis with conservative / operative therapy
- lymphatic oedema
- instability requiring / not requiring revision
- malalignment (over- or undercorrection)
- malpositioning / malsizing of components with / without revision
- implant dislocation (i.e. patella dislocation) with / without revision
- implant breakage
- periprosthetic fracture with conservative / operative therapy
- other fracture with conservative / operative therapy
- allergic reaction to implant material
- ligament rupture (i.e. ligamentum patellae) with / without revision
- remaining foreign body
- fever (< 38.5 C°, < 2 days)
- fistula or abscess with / without revision
- empyema
- osteitis / osteomyelitis with conservative / operative therapy
- septic implant loosening with / without explantation
- aseptic implant loosening with / without explantation
- osteonecrosis
- compartment syndrome requiring / not requiring surgery
- reflex sympathetic dystrophy with reversible symptoms
- reflex sympathetic dystrophy with persisting symptoms
- contracture (> 20°, conservative therapy), temporary or persisting
- contracture (> 20°, operative therapy), temporary or persisting
- spinal anaesthesia syndrome
- thrombophlebitis
- thrombosis
- pulmonary embolus
- pneumonia
- other pulmonary complications
- renal and urinary complications
- cardiac complications
- gastrointestinal complications
- postoperative mental status changes
- other neurologic complications
- death caused by complication
- other complications, not classified before

Table II. — List of all complications in the population of n = 567 TKA's during the follow-up period of one year postoperatively

	<i>percentage</i>	<i>n</i>
delayed wound healing (without infection) – with revision	0.5%	3
– without revision	4.6%	26
superficial wound infection with revision	0.5%	3
deep (intaarticular) infection with revision	0.7%	4
necrosis of skin or subcutaneous tissue with revision	0.4%	2
dehiscence of the wound – with secondary suture/	0.7%	4
– without secondary suture	1.4%	8
neural lesion with temporary sensory/motory loss	0.2%	1
neural lesion with permanent sensory/motory loss	0.2%	1
hematoma without further therapy	0.2%	1
hematoma requiring blood-transfusion or antibiotic treatment	1.4%	8
hematoma requiring revision	0.2%	1
hemarthrosis or effusion – with puncture	0.9%	5
– without puncture	0.5%	3
seroma with conservative therapy	0.5%	3
instability requiring revision	0.5%	3
malpositioning / malsizing of components with revision	0.4%	2
implant dislocation (i.e. patella luxation) with revision	0.4%	2
periprosthetic fracture with operative therapy	0.2%	1
other fracture with operative therapy	0.2%	1
ligament rupture (i.e. ligamentum patellae) with revision	0.5%	3
septic implant loosening with explantation	0.7%	4
thrombosis	1.4%	8
pulmonary embolus	0.2%	1
pneumonia	0.5%	3
other pulmonary complications	1.6%	9
renal and urinary complications	1.8%	10
cardiac complications	0.7%	4
postoperative mental status changes	0.5%	3
other neurologic complications	0.4%	2
other complications, not specified before	3.4%	19

tions (4, 5, 6, 7, 8). Some include early complications such as persisting swelling and haemarthrosis, but most are limited to major complications leading to revision of the knee joint. The principal interest of most studies is survival rate and clinical performance of the implant.

Different methods of assessing and reporting complications are used. Some studies, for example, mention all infections, others only mention those leading to revision. Symptomatic patellofemoral complications are frequent in one study (5), and are not mentioned in other studies. Some of these differences, of cause, are due to the different duration of follow-up: polyethylene wear is often mentioned in long-term studies, but not in shorter follow-ups.

Standardised lists of well-defined complications (1) may help to make international studies comparable. Without standardised lists, it is impossible to determine whether a specific complication (for example haemarthrosis) was not experienced by the author or simply not investigated.

In our study, all complications occurring during hospital stay and the first postoperative year were recorded following a detailed list. The result is a relatively high rate of complications. This meticulous effort is very time-consuming, and is hard to continue in daily routine. Many of the complications we reported have little effect on recovery of the patients or on the long-term success of the implant. With further progress of external quality control and a growing commitment of hospitals to

Table III. — Frequency of complications in patients with and without immunosuppressive medication, depending upon their primary diagnosis (degenerative versus rheumatoid arthritis)

	Diagnosis	Complications
With immunosuppressive medication (n = 50)	O.A. (n = 14)	50% (n = 7)
	R.A. (n = 36)	44.4% (n = 16)
Without immunosuppressive medication (n = 517)	O.A. (n = 504)	24.2% (n = 122)
	R.A. (n = 13)	23.1% (n = 3)

openly reveal their rates of complications, we must discuss which items are worth recording, which items are likely to be reported honestly, and which items are recordable at all. The effort to record complications must be weighed against its practical benefit. In larger arthroplasty registers, the report of complications should be confined to a few, easily traceable and clearly defined parameters, such as all complications leading to revision surgery or other forms of specific therapy.

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