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Long-term Results of Hip and Knee Arthroplasties – A Review of Population-based Results Obtained from the Finnish Arthroplasty Registry

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Abstract

Background: We reviewed the published papers reporting on long-term results of hip and knee arthroplasties based on the Finnish Arthroplasty Registry.

Methods: All articles published in international peer-reviewed orthopaedic journals were analyzed and results of those studies were summarized in this review article.

Results: Cementless total hip replacements, as well as cementless stems and cups analyzed separately, showed a significantly reduced risk of revision for aseptic loosening as compared to the cemented hip replacements in osteoarthritic patients aged less than 74 years. When all revisions were taken into account, however, there were no significant differences between the groups. In patients aged less than 64 years, none of the cemented or cementless total hip replacement designs studied yielded an excellent (>90%) 10-year survivorship. In patients aged 75 years and over, there were no significant differences between different total hip replacement concepts; all of them showed >90% survivorship at 10 years. In younger (<55 years) patients with rheumatoid arthritis, all-poly cementless cups showed a significantly better survivorship than modular cementless cups. On the knee side, unicondylar knee arthroplasties (UKAs) had a 60% and TKAs an 80% survival rate at 15 years with any revision as the end point. The overall survival of UKAs was significantly worse than that of TKAs ($p < 0.001$). All three UKA designs studied had significantly poorer overall survival than the corresponding TKA designs from the same manufacturers. Of the UKA designs, the Oxford meniscal bearing had the highest survivorship of 81% at 10 years, while several TKA designs showed a 10-year survivorship exceeding 90%. In a theoretical cost-benefit analysis, the cost saved by lower implant

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prices and shorter hospital stay associated with UKA as compared to TKA did not cover the costs of the extra revisions.

Conclusions: Cementless total hip replacements have comparable long-term survivorship with cemented replacements in all age groups. In patients aged less than 74 years, cementless stems seem to produce better long-term survivorship than cemented ones. In patients aged 75 years and over, there were no significant differences in the results. Multiple wear-related revisions of the cementless cups in the present study indicate that excessive polyethylene wear is a significant clinical problem with modular cementless cups in all age groups. At a nation-wide level, UKA had a significantly poorer long-term survival than TKA. What is more, UKA did not have even a theoretical cost benefit over TKA in our study. Based on these results, we can not recommend the wide-spread use of UKA in treatment of unicompartmental OA of the knee.

INTRODUCTION

Total hip arthroplasty (THA) with cement has been considered as the gold standard^{4,5}, with which the long-term results of all other total hip replacement (THR) concepts have been compared. However, most of the studies on long-term results of THA refer to only one design in a single centre. Previous population-based studies from Scandinavian arthroplasty registries have reported good results using cemented total hip replacement for older and sedentary patients with primary osteoarthritis^{11, 20, 27}. However, nation-wide survivorships exceeding 10 years have not been published previously.

Unicompartmental knee arthroplasty (UKA) and total knee arthroplasty (TKA) are widely used procedures for osteoarthritis (OA) of the knee. However, epidemiological studies of the knee OA have shown that there are distinct patterns of disease, which principally affect either medial, lateral or patellofemoral compartments¹³. It is noteworthy that up to 25% of patients with OA of the knee suffer from isolated medial compartment disease¹. However, UKA and TKA are both currently used for unicompartmental disease. Population-based long-term results

of these two methods have previously been compared with each other only from the Swedish Knee Registry²⁸.

The purpose of this review article was to evaluate and summarize the population-based long-term results of primary total hip and knee arthroplasties in Finland. To obtain this goal, we reviewed all recent studies from the Finnish Arthroplasty Registry published in international peer-reviewed orthopaedic journals.

PATIENTS AND METHODS

The Finnish Arthroplasty Registry

Finland has a population of about 5.2 million. Since 1980, the Finnish Arthroplasty Registry^{24, 27} has been collecting information on hip and knee replacements. Health care authorities, institutions and orthopaedic units are obliged to provide the National Agency for Medicines with information that is essential for maintenance of the registry. The coverage of the Finnish Arthroplasty Registry was analyzed in 1994–1995 by comparing its data with those of the discharge registries of participating hospitals; it was found to cover 90% of implantations. Since 1995, the data of the registry have been compared with that of hospital discharge

registries every few years. Currently, 98% of implantations are recorded. An English translation of the notification form used by the Finnish Arthroplasty Registry has been discussed previously²⁷⁾.

Published studies

From 2005 to 2008, five studies on the nation-wide results of total hip arthroplasty^{6-8, 18, 19)} and two studies about unicompartmental and total knee arthroplasties^{16, 17)} based on the data recorded in the Finnish Arthroplasty Registry were published in international peer-reviewed journals. In this review article, we summarize and discuss the results of those studies.

RESULTS

Total hip arthroplasty

Younger patients (aged less than 55 years)

The risk of stem revision due to aseptic loosening in young patients with primary OA was significantly higher for cemented stems than for proximally porous-coated or HA-coated uncemented stems implanted over 1980–2001 (Fig. 1). The risk of revision for all-poly cemented-cups implanted during the same period was higher than that for press-fit porous-coated uncemented-cups when aseptic loosening was used as the end point. However, there was no longer any difference in the risk between these two design concepts when the end point was defined as any revision (including exchange of liner)⁶⁾.

All uncemented stem designs studied in young patients with primary OA had over 90% survivorship at 10 years. The Biomet Bi-Metric stem had a 95% (95% CI 93–97) survival rate even at 15 years. The Biomet Universal, the ABG II and the Harris-Galante II cups had >90% survival rates at 10 years when aseptic loosening was used as

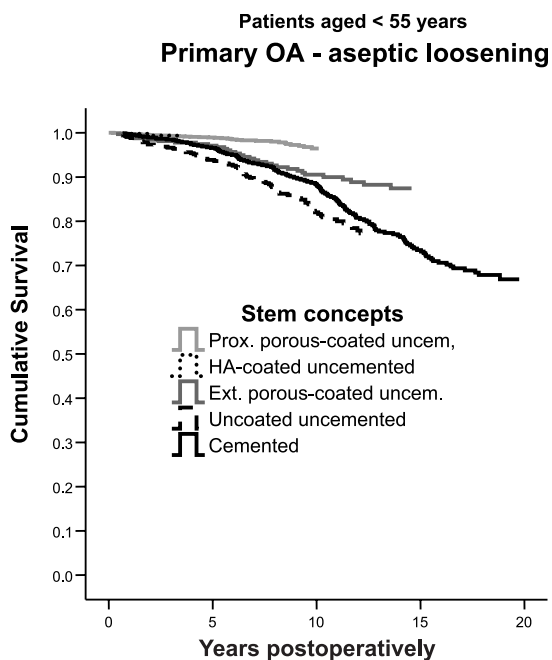


Fig. 1 Cox-adjusted survivorship curves of 4315 femoral components in patients who were less than fifty-five years of age and stratified according to the implant group. The end point was defined as revision of the stem because of aseptic loosening. Adjustment was made for age and gender.

the end point. When the end point was defined as any revision (incl. exchange of liner), 10 year survival rates of all cup brands except the Harris-Galante II decreased to less than 80%. Thus, none of the uncemented THR designs studied showed over 90% survivorship at 10 years⁷⁾.

In young patients with RA, the risk of stem revision due to aseptic loosening was significantly higher with cemented stems than with proximally porous-coated uncemented stems. In contrast, the risk of cup revision was significantly higher for all uncemented cup concepts than for all-poly cemented cups with any type of cup revision as the end point⁸⁾.

Older patients (≥ 55 years of age)

Cementless total hip replacements, as well as cementless stems and cups analyzed separately, had a significantly reduced risk of revision for aseptic loosening as compared to cemented hip replacements (Fig. 2). When revision for any reason served as the end point in survival analyses, however, there were no significant differences between the groups (Fig. 3). In patients aged 55 to 64 years, the 15-year survival rates of the two cementless groups were higher (78% and 80%) than that of the cemented replacements (71%) with revision for aseptic loosening as the end point. In patients aged 65 to 74 years, the 15-year survivorship of the cementless group #1 (cementless straight proximally circum-

ferentially porous-coated stem combined with a modular cementless press-fit porous-coated cup) was 94%, while cemented total hip replacements showed an 85% survival rate. In patients aged 75 years and over, there were no significant differences between the total hip replacement groups; all of them showed over 90% survivorship at ten years¹⁹.

Only two stem designs, the Exeter Universal and the Muller Straight, showed over 95% survivorship at 10 years with revision for aseptic loosening as the end-point. At 15 years, only the Exeter Universal/Exeter All-poly total hip replacement had over 90% survival rate with revision for aseptic loosening as the end-point. In the subgroup of patients

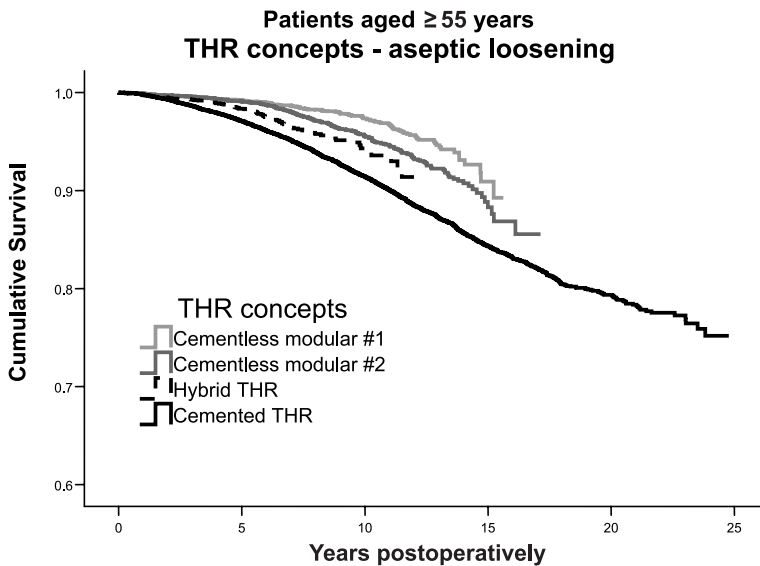


Fig. 2 Cox-adjusted survivorship curves of 50 968 total hip replacements (THR) in patients who were fifty-five years of age or older and stratified according to the implant group. The end point was defined as revision of the stem and/or the cup because of aseptic loosening. Adjustment was made for age and sex. Both cementless groups and the group of hybrid replacements had a significantly better overall rate of survival than did the reference group of cemented hip replacements ($p < 0.001$ for all comparisons). Reprinted with permission from The Journal of Bone and Joint Surgery, Inc. (Mäkelä KT, Eskelinen A, Pulkkinen P, Paavolainen P, Remes V. Total Hip Arthroplasty for Primary Osteoarthritis in Patients Fifty-five Years of Age or Older. An Analysis of the Finnish Arthroplasty Registry. *J Bone Joint Surg Am* 2008 90: 2160.). The original coloured figure modified to monochrome layout.

aged 55 to 64 years, 10-year survivorship all cemented total hip replacements was less than 90%¹⁸⁾.

Knee arthroplasty

Unicondylar arthroplasty

The number of UKA operations increased markedly during recent years in Finland. At the time of the operation, the mean age of the patients was 65 years (range, 38 to 91 years). Analysis of the whole study period (1980–2003) showed that UKAs had a 73.0% (95% CI 69.6–76.4) survival rate at 10 years follow-up with revision for any reason as the end point. Those patients who received the Oxford meniscal bearing unicondylar (n=1145) had a survival rate: 81% (95% CI 72–

89) at 10 years (**Fig. 4**). The group who received the Miller-Galante II unicondylar (n=330) had a 79% survival rate (95% CI 71–87) at 10 years follow-up, whereas the Duracon (n=196) had 78% (95% CI 72–84), and the PCA (n=146) 53% (95% CI 45–60), respectively. Younger patients (≤ 65 years) were found to have a 1.5 -fold (95% CI 1.1–2.0; $p=0.04$) increased risk of revision compared to older patients (>65 years)¹⁶⁾.

Unicondylar vs. total knee arthroplasty

UKAs had a 60% (95% CI 54–66) and TKAs an 80% (95% CI 79–81) survival rate at 15 years with any revision taken as the end point. Overall survival of UKAs was significantly worse than that of TKAs ($p <$

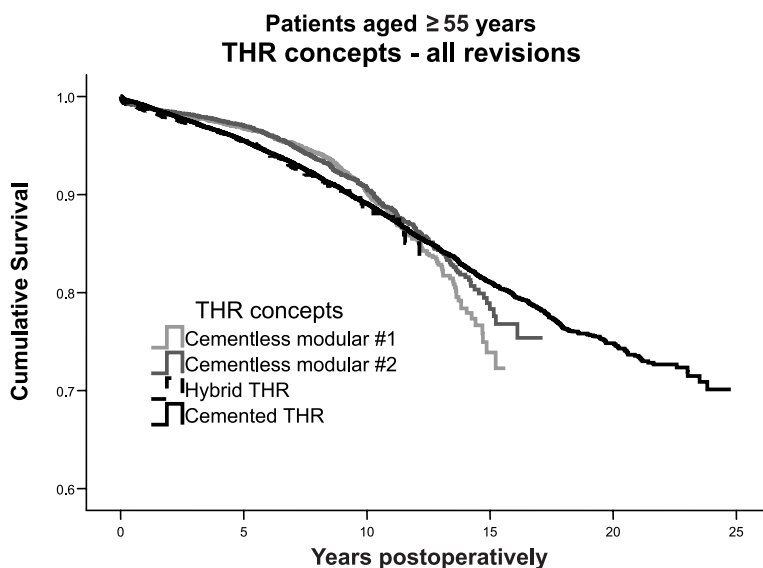


Fig. 3 Cox-adjusted survivorship curves of 50,968 total hip replacements (THR) in patients who were fifty-five years of age or older and stratified according to the implant group. The end point was defined as revision of the stem and/or the cup for any reason. Adjustment was made for age and sex. The differences in survival rates among the total hip replacement groups were not significant. Reprinted with permission from The Journal of Bone and Joint Surgery, Inc. (Mäkelä KT, Eskelinen A, Pulkkinen P, Paavolainen P, Remes V. Total Hip Arthroplasty for Primary Osteoarthritis in Patients Fifty-five Years of Age or Older. An Analysis of the Finnish Arthroplasty Registry. *J Bone Joint Surg Am* 2008 90: 2160.). The original coloured figure modified to monochrome layout.

Survival - UKA designs

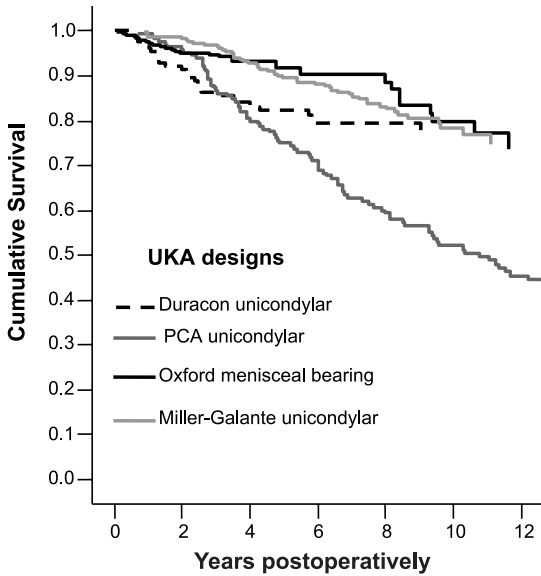


Fig. 4 Cox-adjusted survival curves of 1736 UKAs in patients with primary osteoarthritis. UKA design serves as the strata factor. The endpoint is defined as revision for any reason. Adjustment made for age and gender. Reproduced with permission and copyright © of Acta Orthopaedica (Koskinen E, Paavolainen P, Eskelinen A, Pulkkinen P, Remes V. Unicondylar knee replacement for primary osteoarthritis – a prospective follow-up study of 1886 patients from the Finnish Arthroplasty Register. *Acta Orthop* 2007; 78: 128–35.). The original coloured figure modified to monochrome layout.

Survivorship of UKAs and TKAs

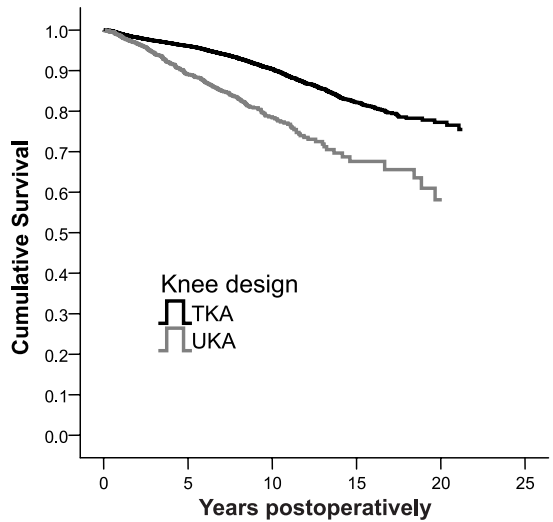


Fig. 5 Cox-adjusted survival curves for 48 607 TKAs and 1 886 UKAs. The endpoint was defined as revision for any reason. Adjustment was made for age and sex. Reproduced with permission and copyright © of Acta Orthopaedica (Koskinen E, Eskelinen A, Paavolainen P, Pulkkinen P, Remes V. Comparison of survival and cost-effectiveness between unicondylar arthroplasty and total knee arthroplasty in patients with primary osteoarthritis: a follow-up study of 50,493 knee replacements from the Finnish Arthroplasty Register. *Acta Orthop.* 2008; 79: 499–507.). The original coloured figure modified to monochrome layout.

0.001; Fig. 5). Survivorship of UKAs did not improve significantly during the follow-up period. In case of TKAs, on the contrary, TKAs implanted during 1996–2003 showed a significantly reduced risk of revision as compared to TKAs operated on earlier. All three UKA designs had significantly poorer overall survival than the corresponding TKA designs from the same manufacturers. In the theoretical cost-benefit analysis, the cost

saved by lower implant prices and shorter hospital stay of UKA as compared to TKA did not cover the costs of the extra revisions¹⁷.

DISCUSSION

In the published registry-based studies from the Finnish Arthroplasty Registry, it was found that uncemented proximally circumferentially porous- and HA-coated

stems provided patients in all age groups with good long-term outcomes. Modern uncemented cup concepts also showed good resistance against aseptic loosening. Thus, biologic fixation of hip implants was found to be a reliable method irrespective of the patient's age. However, multiple wear-related revisions had to be performed, which led to unsatisfactorily low long-term survivorship of modular uncemented cups. In patients aged less than 65 years, long-term survivorship of cemented prostheses was less than optimal and clearly poorer than previously reported from single centres. In young patients with RA, uncemented proximally circumferentially porous-coated stems and cemented all-poly cups provided the best long-term results. Considerable differences were also found in the long-term survival of cemented prostheses in patients aged 55 years or older in Finland. On the knee side, UKA had a significantly poorer survival than TKA in patients with primary OA of the knee in Finland. Further, survivorship of UKAs did not improve during the 24-year follow-up period, while that of TKAs significantly increased at the same time. In addition to the significant difference in survival rates, UKA did not have even a theoretical cost benefit over TKA despite lower implant costs and a shorter hospital stay.

Validity of the data

Registry-based studies provide valuable insight into the use of hip and knee arthroplasties in a certain patient-group, as the number of arthroplasties studied is significantly larger in register-based studies than in clinical studies from single centers¹⁴. In addition, such nationwide studies enable trends in joint arthroplasty to be shown better and on a larger scale. Further, the

results can be compared with those of other Nordic arthroplasty registers, which gives a broad perspective on the results for both single implants and the methods applied in arthroplasty surgery.

However, registry-based studies have certain limitations. The coverage of the Finnish Arthroplasty Registry before 1994–1995 was only 90%. Thus 10% of the data of prostheses before 1994 are missing. These prostheses may have caused bias in the published studies. It is also possible, that a few centres performed the majority of implantations of certain designs. However, a single centre with poor results has unlikely a major effect on results in a study with very high number of implants. Moreover, it is the purpose of register studies to evaluate population-based results with hospitals of variable standards.

Another limitation of registry-based studies is that only a revision operation is used as a definition of failure. There may be patients with osteolysis or loosened implants, who are too ill to undergo revision surgery or who simply prefer not to do so. Subjective outcome measurements, e.g., Harris Hip Score or disease-specific quality of life measurements cannot be used either. Moreover, in registry-based studies with thousands of patients it is not possible to conduct radiographic analyses. And when young patients are concerned, a registry-based study may have diagnostic pitfalls in that a small proportion of the patients diagnosed with primary osteoarthritis may in fact have mild developmental dysplasia (DDH)¹⁰. It has been reported that patients with DDH of the hip may have poorer outcome of THA than other patient groups⁹.

In the cost-benefit analysis of UKAs and TKAs only direct hospital-related gross costs were included using year 2003 as the base

year¹⁵). There are also patient-related indirect costs such as the need for pain medication at home, sick-leaves, physiotherapy etc. What is more, all hospitals used same price for each day in hospital. In practice, the last days the patient stays in hospital are probably cheaper than the first postoperative days, as patients need less help and medication and are more independent in activities of daily living. When prices of revisions are concerned, it must be kept in mind, that every new procedure also predisposes the patient to complications. Moreover, a new procedure has its own learning curve which may influence the results of the first years and generations of UKA. However, registry-based studies reflect the true performance of surgical procedures on a nation-wide basis.

When evaluating the published results of hip and knee arthroplasties, we should evaluate studies based on registries and those reported by single centers from different points of view. Results from these different sources are not, however, exclusive; on the contrary, they complement each other. Both types of studies will certainly be needed in future evaluations of the results of implants and the methods used in arthroplasty surgery.

Long-term results of total hip arthroplasty

In the published studies on total hip arthroplasty from the Finnish Registry, long-term survivorship of cementless stems, with aseptic loosening as the end point, was superior to that of cemented stems in patients who were less than 75 years old^{6, 7, 18, 19}. To our knowledge, this finding has not been reported previously. What is more, the results of those studies suggest that the long-term survivorship of cementless cups, with aseptic loosening as the end point, is as good as that

of cemented cups also in this same age group. However, the large number of wear-related revisions of modular cementless cups in all age groups is an alarming finding, which clearly emphasizes the need for more wear-resistant articulations for cementless cups. The problem of cup-liner incongruity with the two-piece acetabular designs with an incomplete locking mechanism was emphasized in studies from the Finnish Registry because of the large proportion of such cup designs that have been reported to have a high prevalence of liner problems^{25, 26}.

Recent Scandinavian registry-based studies have shown excellent long-term survivorship for cemented total hip replacements in patients with primary osteoarthritis, based on nationwide data^{11, 20}. In 2000, six well-documented cemented prostheses constituted 70% of the market in Sweden, and had 9- to 10-year survival rates ranging from 93 to 98% in the Swedish Arthroplasty Registry²⁰. The survival of cemented stems was markedly better than survival of cementless stems²⁰. The difference in survivorship of cementless and cemented implants both in younger and in elderly patients in Finnish and Swedish national registries is interesting. In Finland, the tradition of cementless total hip arthroplasty is strong. In Sweden, use of cementless implants has not been as common as in Finland^{12, 20}. In our opinion, reports from the Swedish Arthroplasty Registry have not taken into account substantial differences between cementless hip replacements, some of which have proved to have excellent^{2, 6, 7, 21} and some catastrophic^{25, 29} long-term results. We think that the survival data of cementless implants should be analyzed and presented in implant groups. On the other hand, systematic instruction of cementing techniques and reporting of the

results were started very early in Sweden, which has certainly aided in achieving the high long-term survivorship of cemented replacements reported from the Swedish registry.

Unicondylar vs. total knee arthroplasty

It seems that the Finnish results of UKA are not similar to those reported by surgeons designing UKAs, or with those results from specialized centers²³. Based on the Swedish arthroplasty register, Robertsson et al.²⁸ showed that the long-term results of the UKA are related to the number of UKAs performed by a hospital. In particular, that the technically demanding implant (Oxford) was most affected by volume in that hospital. In the Finnish study by Koskinen et al.¹⁶, the Oxford unicondylar arthroplasty had the best survivorship of the UKAs studied. However, a word of caution is needed. In a recent study based on the Swedish Knee Registry²⁸, results from 1987 to 1998 showed that the Oxford mobile bearing had a significantly higher cumulative revision rate (CRR) than fixed-bearing models. Moreover, the higher CRR for the Oxford UKA was associated with hospitals with low surgical volume for knee arthroplasty²⁸. On the other hand, good long-term survivorships have been also obtained with fixed-plateau type UKAs in single-centre studies^{3, 22}.

In a study from the Swedish knee arthroplasty register, Knutson et al.¹⁵ found that the overall cumulative revision rates were significantly higher for UKAs than for TKAs. This finding was confirmed in the recent study from the Finnish Arthroplasty Register¹⁷. It is clear that nation-wide results of UKA are not similar to those reported by surgeons designing UKAs, or with those results from specialized centres²³. It is

also notable, that the survival rates of UKAs did not improve during the 24-year follow-up period in Finland. On the contrary, UKAs implanted before 1988 had higher survival than UKAs implanted after that year. This was evident, even though more modern UKA design came to market in the late 1990s. This is in accordance with the findings reported by Knutson and co-workers¹⁵ from the Swedish Arthroplasty Register: survival rates for some recently introduced UKA concepts (Oxford, Brigham) were inferior to those of older designs. At the same, however, survival of TKAs improved significantly in Finland. It is clear that in wide-spread use UKA has a significantly poorer survival than TKA.

In the study by Koskinen et al.¹⁷ from the Finnish Arthroplasty Registry, UKA did not even show a theoretical cost-benefit over TKA. The savings due to lower implant costs and a shorter hospital stay of UKA were not sufficient to cover the costs of numerous extra revisions. On the other hand, revision of UKA is probably cheaper than revision of TKA due lower implant costs. However, in Finland hospitals use commonly DRG prices (diagnosis related group). It does not differentiate between revision for UKA or TKA. Thus the authors were unable to provide different prices for UKA and TKA revision. In addition, it is possible that need of pain medication and rehabilitation is less after UKA and survival after revision UKA is better than survival after revision of TKA. All these factors would even out observed difference.

CONCLUSIONS

Cementless total hip replacements have comparable long-term survivorship with cemented replacements in all age groups. In

patients aged less than 74 years, cementless stems seem to produce better long-term survivorship than cemented ones. In patients aged 75 years and over, there were no significant differences in results. Multiple wear-related revisions of the cementless cups in the present study indicate that excessive polyethylene wear is a significant clinical problem with modular cementless cups in all age groups. At a nation-wide level, UKA had a significantly poorer long-term survival than TKA. What is more, UKA did not have even a theoretical cost benefit over TKA in our study. Based on these results, we can not recommend wide-spread use of UKA in treatment of unicompartmental OA of the knee.

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