Knee Surg Sports Traumatol Arthrosc
(2004) 12 : 140–143

KNEE

DOI 10.1007/s00167-003-0401-8

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Quality of life and clinical outcome in salvage revision total knee replacement: hinged vs. total condylar design

Received: 9 January 2003
Accepted: 20 April 2003
Published online: 21 August 2003

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Abstract This study compared the overall outcome after salvage revision total knee arthroplasty using hinged and nonhinged designs. We followed 26 total knee arthroplasties for an average of 20.4 months. The average age was 68.5 years. All patients had a salvage situation secondary to excessive bone loss, enlarged flexion gap, collateral ligament insufficiency, or extensor mechanism insufficiency. Ten patients received a hinged implant after an average of 2.8 prior total knee replacements. Sixteen patients received nonhinged constrained implants after an average of 3.4 prior total knee replacements. The outcome was evaluated using the Hospital for Special Surgery Score (HSS), the Knee Society Score (KSS), the Visual Analogue Scale for pain (VAS), the Tegner Activity Score, the Patella Score, and the Short Form-36 Health Survey (SF-36). There was a statistically significant difference in flexion range of motion between hinged and nonhinged designs (96.5° vs. 107.5°) but not in HSS, KSS, VAS, Tegner Activity Score, or Patella Score. Patients with hinged and nonhinged prostheses had significantly lower scores than an age-matched normal population in physical functioning, role limitations, and bodily pain on the SF-36 survey. However, patients with a hinged implant had no statistically significant difference compared to controls in the mental component summary. In salvage total knee arthroplasty the implant design does not significantly affect the overall functional outcome. However, patients with a hinged implant had significant better scores in the mental components of the SF36 quality-of-life assessment.

Keywords Revision total knee · Salvage · Hinged · Total condylar design

Introduction

The number of primary total knee replacements being performed worldwide is rising each year. An increasing number of revisions are therefore seen, and more are to be expected in the future. The annual incidence of prosthetic revisions has increased to 7.8% in the United States [9]. In the Swedish knee arthroplasty register revisions account for approximately 13% of all total knee arthroplasties [12]. Revision total knee arthroplasty is complicated by bony defects, ligamentous instability, and soft tissue compromise. Currently there is a trend towards modular revision total knee implants that offer a variety fixation and reconstruction options [4]. Today these modular total condylar implant designs are used almost exclusively for primary and secondary revision arthroplasty. However, hinged implants may be indicated in the salvage situation facing massive bony defects with resulting extension and flexion gap mismatch and complete loss of the medial collateral ligament [3, 5].

To the authors' knowledge, two studies have compared a modular rotating hinge design for salvage revision total knee arthroplasties with a standard condylar revision pros-

theses in an uncomplicated revision setting [3, 16], but no study provides a comprehensive comparison of hinged and total condylar revision implants in a salvage situation. We examined patients who underwent multiple aseptic or septic revisions using either a hinged or a modular total condylar revision implant. In addition to a thorough investigation of the clinical and radiographic outcome this study provides information on the impact on the overall quality of life.

Material and methods

We retrospectively evaluated 25 patients with 26 revision total knee replacements in a clinical and radiological follow-up examination. Their mean age at the time of surgery was 68.5 years (range 41–83), and mean follow-up was 20.4 months (range 9–47). Patients included in the current study underwent an average of 3.2 total knee replacements (range 1–4) prior to definitive surgery. All patients had a salvage situation secondary to excessive bone loss, enlarged flexion gap, collateral ligament insufficiency, or extensor mechanism insufficiency. The indication for a hinged implant was based on whether the medial collateral ligament was completely absent [3, 5]. The ten patients with an infected salvage total knee revision met these criteria and received a hinged implant (GSB, Sulzer, Freiburg, Germany). Patients with a hinged implant design underwent an average of 2.8 prior total knee replacements. Their mean age was 72.9 years (range 41–83), and mean follow-up was 24.6 months (range 9–45). The reimplantation was postponed until the C-reactive protein level returned to normal and was usually performed 19.2 days (range 12–29 days) after explantation of the septic arthroplasty. A cemented spacer prevented soft tissue shrinkage. All 16 noninfected knees received a constrained, nonhinged implant (Genesis II, Smith & Nephew, Schenefeld, Germany) after an average of 3.4 prior total knee replacements. The patients' mean age was 65.7 years (range 56–75), and mean follow-up was 17.8 months (range 6–47 months).

Clinical examination used the visual analogue scale for pain, the Tegner Activity Score, Patella Score, Hospital for Special Surgery Score, and the Knee Society Score. Quality of life was analyzed with the Short Form-36 Health Survey SF-36. Radiological evaluation was performed according to the criteria of the Knee Society and the defect classification established by Engh. Statistical analysis was performed using Wilcoxon ranged sum test; P values of less than 0.05 were considered statistically significant.

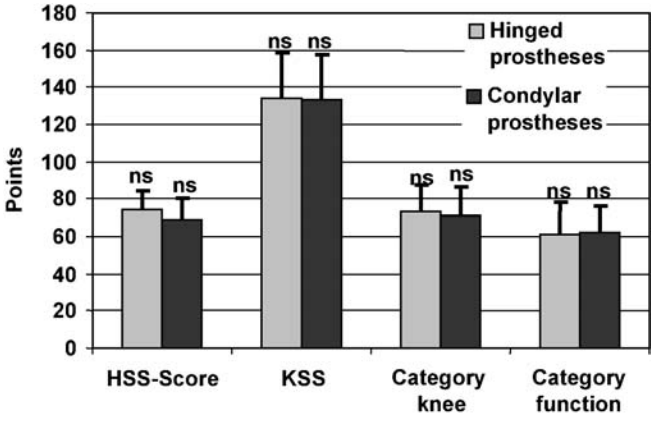

Fig. 1 Functional outcome using the Hospital for Special Surgery Score (*HSS*) and the Knee Society Score (*KSS*) after salvage revision total knee replacement using hinged and total condylar revision implants

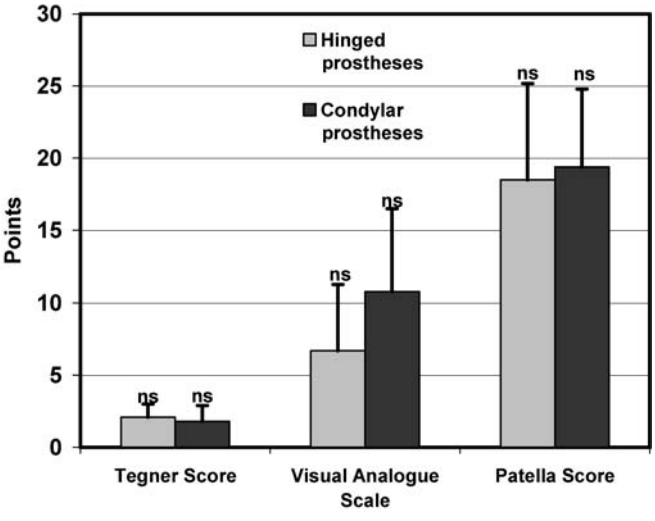

Fig. 2 Tegner Score, visual analogue scale, and Patella Score after salvage revision total knee replacement using hinged and total condylar revision implants

Results

The functional evaluation showed an average range of motion of 103.3±18.7°. Patients with a hinged implant achieved an average flexion of 96.5° (range 50–125°) and patients in the total condylar group achieved an average flexion of 107.5° (range 70–140°). This difference was statistically significant (P<0.05). There was no statistically significant difference in the average extension lag between hinged (1.5°) and nonhinged implants (0°).

The mean value on the Hospital for Special Surgery Score was 71.3 points: 74.6 with the hinged prosthesis and 69.3 points with the condylar. The overall Knee Society Score averaged 133.4 points: 133 with the hinged implant and 133.1 with the condylar. Knee and function scores were 73.4 and 61.5, respectively, with the hinged prosthesis and 71.3 points and 61.8 with the condylar (Fig. 1). The mean Tegner Activity Score (maximum 10) was 1.9 points: 2.1 with the hinged prosthesis and 1.8 with the condylar. The mean visual analog scale for pain (maximum 20) was 9.2±5.6; this was 6.7 with the hinged implant and 10.8 with the condylar (n.s.). There was no statistically significant difference in the Patella Score between patients with a hinged implant (18.5 points) and those with a constrained total condylar implant (19.4 points; Fig. 2).

Quality-of-life data are presented in Table 1. Both groups had significantly lower scores in physical function, physical role limitations, bodily pain, and the physical component summary compared with healthy controls. However, there was no significant difference between patients with

Table 1 SF-36 quality-of-life measurement in patients after salvage total knee revision and in normal control group

Items	Hinge design vs. control	Condylar design vs. control
Physical functioning	0.0001	0.0001
Physical role limitations	0.0076	0.0001
Bodily pain	0.0398	0.0001
General health perception	0.7357	0.0019
Vitality	0.1882	0.2356
Social functioning	0.3487	0.0001
Emotional role limitation	0.2525	0.0001
General mental health	0.2550	0.0288
Change in health status	0.1200	0.4789
Physical component summary	0.0019	0.0001
Mental component summary	0.4644	0.0381

hinged implants and controls on the mental component summary. In contrast, patients who underwent multiple revisions for aseptic loosening and had received a modular total condylar implant had significantly lower scores in general health perception, social functioning, emotional role limitation, general mental health, and the mental component summary (Table 1). There was no significant difference between the two groups in the preoperative staging of bony defects according to the Engh classification. There was also no significant correlation between body mass index and clinical scores (P=0.25).

Discussion

Primary total knee replacement is a highly successful operation with survival rates approaching 95% at 15-year follow-up [10]. The results of revision total knee replacement have been less encouraging. One study found 42% of patients to have poor functional outcome or implant failure after an average of 5 years [6]. In salvage revision total knee replacement the surgeon often confronts large flexion gaps, absence of collateral ligaments, and extensor mechanism insufficiency. In this situation some authors favor hinged implant designs [5]. The current study evaluated patients undergoing salvage total knee revision after numerous aseptic or septic implant revisions to evaluate the impact of implant design on functional outcome and quality of life.

Patients with a modular total condylar revision implant had a significantly better flexion range of motion than patients receiving a hinged implant. An average postoperative range of motion of 100° degree flexion and more has been reported in patients undergoing revision total knee replacement with condylar revision implants [3, 11]. There is evidence of decreased range of motion in patients with hinged implants. Springer et al. [14] observed an average range of motion of 94.2° after implantation of a rotating hinge type prosthesis. Although not statistically significant, Barrack et al. [3] reported a difference in postoperative range of motion between a rotating hinged implant (mean 93°) and a standard condylar design (mean 101°). According to the literature and the data presented in the current study, decreased range of motion may be a disadvantage of hinged implant designs in salvage revision total knee replacement.

Although patients with the condylar type implant had some advantage in flexion range of motion, those with hinged implants showed a trend toward lower pain levels in the visual analog scale. There was no significant difference in the functional outcome between the two groups. These data are supported by Barrack et al. [3] who found an average postoperative Knee Society Clinical Score of 131 in the hinged group and 137 in the standard condylar revision group. There is no evidence in the literature that implant selection has a significant impact on the overall functional outcome after revision total knee replacement.

Studies assessing quality of life following revision total knee replacement are rare. Although both groups in the current study showed significantly more restriction than age-matched controls, there were clearly less difference in patients with a hinged prosthesis. This advantage was found principally in parameters of the mental quality of life (Table 1). Barrack et al. [3] compared hinged and condylar implant designs for revision total knee replacement. They evaluated 15 hinged and 87 condylar prostheses. In contrast to our study, their evaluation did not include a quality-of-life assessment. Despite the fact that the hinged design was used in patients with more severe bone loss and lower preoperative Knee Society Clinical Scores, outcome in patients with a hinged implant was not functionally inferior. However, Barrack and coworkers [3] emphasized that it is necessary to have approx. 1100 knees (1000 condylar and 100 hinged implants) for the study to possess sufficient statistical power to determine a functional difference between the two implants. The current study lacked a sufficient number of cases for statistical assessment of functional outcome, but it nevertheless provides new information regarding quality of life after salvage total knee revision.

Although initial fixed hinge devices had high rates of tibial loosening and metal debris generation secondary to transmission of abnormal high stresses to the bone-cement interface, a number of studies have shown good long-term results and functional outcome using modern rotating hinged implants [1, 7, 8, 15]. The GSB II implant used in the current study has proven to have a good medium term survival rate; however, 15-year survival rates are reported to be as low as 56% [15]. Rotating hinge components have now gained wide acceptance in the salvage revision setting [2]. While long-term data are missing, short-term survival rates are promising [13, 16, 17]. The current study suggests that there is an indication for hinged revi-

sion implants in the salvage situation despite the versatility of modern modular constrained revision knee systems. According to our findings, hinged knee designs should be considered in patients with multiple revisions and resulting severe bone loss, excessive flexion gap, and extensor mechanism insufficiency [16]. Long-term follow-up studies are necessary to evaluate whether good early results are sustained over a longer period.

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