

H. Effenberger · J. Berka · G. Hilzensauer  
T. Ramsauer · U. Dorn · E. Kießlinger

## Miller-Galante total knee arthroplasty: the importance of material and design on the revision rate

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**Abstract** We have reviewed 142 Miller-Galante I (MG I) total knee arthroplasties (TKAs) with a follow-up of 56 months, and compared these with the outcome of 219 Miller-Galante II (MG II) TKAs with a follow-up of 36 months. In the MG II TKAs we found markedly lower revision rates, higher postoperative Hospital for Special Surgery (HSS) scores, less retropatellar pain and better patellar centring without patellar resurfacing. The higher revision rate in MG I TKAs was mainly due to the need to revise the metal-backed patellae.

**Résumé** Nous avons étudié le résultat de 142 arthroplasties totale du genou Miller-Galante I faites de 1987 à 1993 avec un suivi de 56 mois et les avons comparés avec le résultat de 219 arthroplasties Miller-Galante II opéré de 1992 à 1995 avec un suivi de 36 mois. Avec la prothèse Miller-Galante II nous avons trouvé un taux de révision plus faible, un plus haut score (HSS) postopératoire, moins de douleurs rétro-rotuliennes et un meilleur centrage rotulien sans resurfacage de la rotule. La révision de la prothèse rotulienne avec métal-back était la cause principale des reprises des prothèses de type Miller-Galante I.

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H. Effenberger (✉) · J. Berka · G. Hilzensauer · T. Ramsauer  
U. Dorn  
Orthopaedic Department, Salzburg General Hospital,  
5020 Salzburg, Austria  
e-mail: h.effenberger@teling.at

H. Effenberger  
Rossmarkt 25, 4710 Grieskirchen, Austria

E. Kießlinger  
Am Kohlenschacht 59, 93077 Bad Abbach, Germany

### Introduction

The Miller-Galante prosthesis has been used since the mid 1980s. Uncemented fixation is achieved on the femur primarily by ‘clamping’ with secondary stability resulting from osseointegration into a multi-layered titanium fiber-mesh. The uncemented implant is fixed to the tibia with titanium screws and pegs. The uncemented version for patellar resurfacing consists of a metal-backed patella which is fixed with fiber-mesh pegs. The Miller-Galante I system is characterised by a flat patellar groove, metal-backed patella and its flat tibial polyethylene onlay. To improve patellar centring, the Miller-Galante II system is designed with the patellar bed more deeply recessed into the femur, and the femoral curvature more evenly curved. The tibial pegs are reinforced, and a 10° displacement of the tibial fixation screw allows variable positioning.

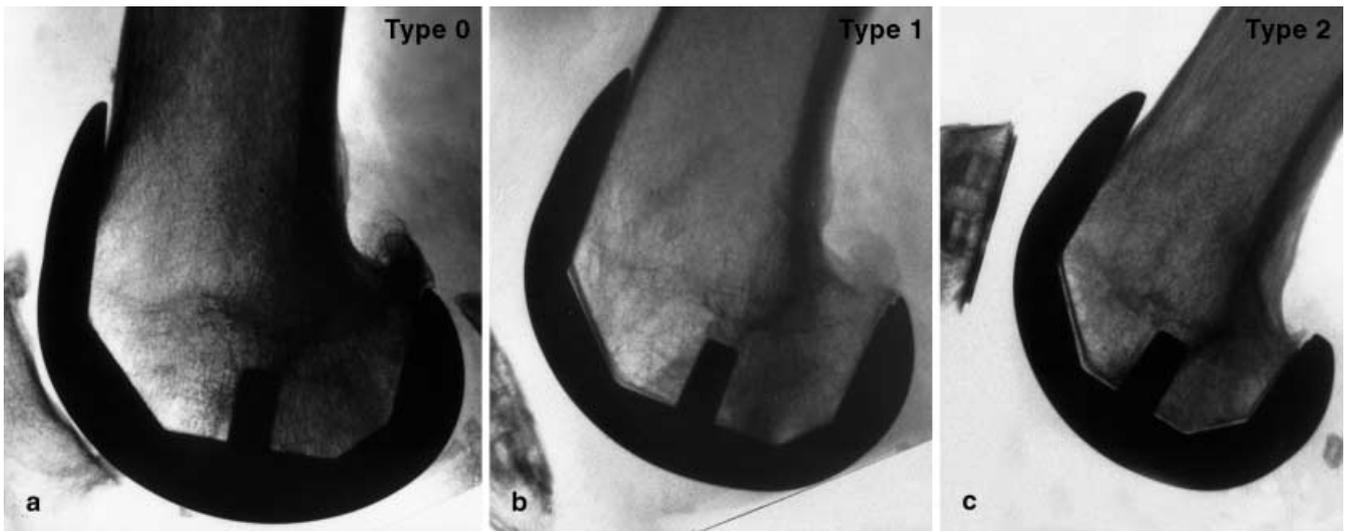
### Materials and methods

Between 1987 and 1993 we performed 190 MG I knee arthroplasties in 175 patients (Table 1). In 152 the diagnosis was idiopathic gonarthrosis, in 28 rheumatoid arthritis, in five post-traumatic gonarthrosis and in five Ahlbäck’s disease.

Between 1992 and 1995 we used only the MG II cruciate retaining implant in 274 knee arthroplasties in 256 patients

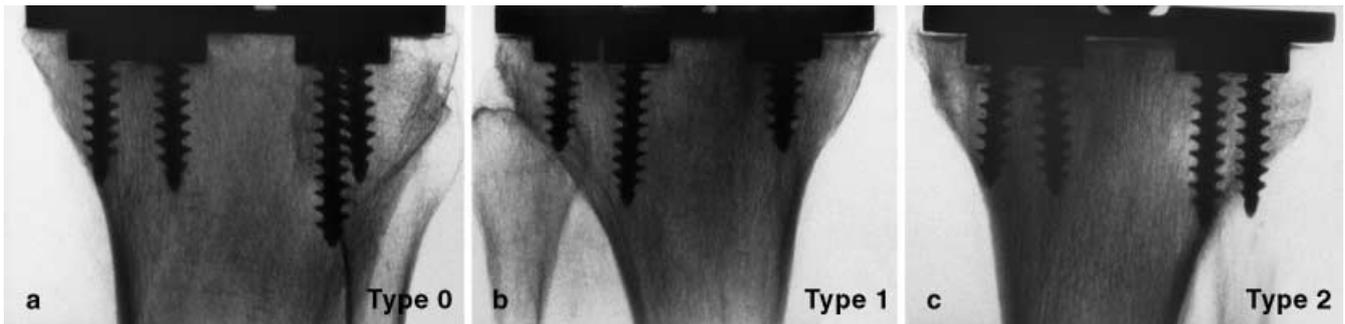
**Table 1** Materials and methods

	Miller-Galante I	Miller-Galante II
Total TKA	190	274
Patients’ age (years)	Ø 69 (43–89)	Ø 71 (33–86)
Uncemented TKA	118	95
Hybrid type of TKA	40	137
Cemented TKA	32	42
TKA with patellar resurfacing	108	123
Metal-backed patella, cementless	32	–
Metal-backed patella, cemented	7	–
Polyethylene-patella	69	123
TKA without patellar resurfacing	82	151



**Fig. 1** MG I uncemented femoral components with radiolucency Type 0, 1 and 2. **a** Type 0 (no radiolucency), **b** Type 1 (radiolucency not more than one third of bone contact area), **c** Type 2 (radio-

lucency not more than two thirds of bone contact area). Type 3 (complete radiolucency) not shown



**Fig. 2** MG II uncemented tibial components with radiolucency Type 0, 1 and 2. **a** Type 0 (no radiolucency), **b** Type 1 (radiolucency not more than one third of bone contact area), **c** Type 2 (radiolucency not more than two thirds of bone contact area)

(Table 1). In 240 the diagnosis was idiopathic gonarthrosis, in 16 rheumatoid arthritis, in nine post-traumatic gonarthrosis and in nine Ahlbäck's disease.

Prospective assessment was made using the Hospital for Special Surgery score (HSS score) and antero-posterior, lateral and patella-tangential radiographs were taken pre- and postoperatively. A preoperative radiograph of the entire lower limb while standing was also necessary for preparing the preoperative sketch [3].

Radiological assessment of both uncemented and cemented femoral and tibial implants included the extent of radiolucency at the border zone and used the following classification: no radiolucency = Type 0, radiolucency of up to one third = Type 1, not more than than two thirds = Type 2, more than two thirds = Type 3 (Figs. 1, 2).

The  $\chi^2$ -test and Fisher's exact test were used for statistical analysis. Survival analysis (Kaplan-Meier method) was performed using SPSS software.

## Results

Clinical follow-up and radiographic assessment was carried out in 131 patients with 142 MG I TKAs. The

mean follow-up period was 56 months (range: 12–122 months). The HSS score increased from 46 points before surgery to 81 points after operation. Postoperative flexion was reduced by 1° when compared to the preoperative 105°. In 27 arthroplasties revision surgery became necessary.

Revision surgery was necessary in 28 cases. To date, 10 out of 32 uncemented metal-backed patellae have had to be revised. In 7 of these 10 patients, patella and femur were replaced due to destruction of the titanium femur components. Other revisions were carried out because of early (n=1) and late infection (n=1), broken tibia peg (n=2), loosening (n=1) or fracture (n=2) of the tibia plateau, limited range of motion (n=1) or due to instability (n=5). In 6 cases a secondary patella replacement was carried out because of patellofemoral instability and anterior knee pain. One patella fracture was not revised because symptoms were not severe; the patient has meanwhile died.

Of 66 patients without patellar replacement, 52 had no anterior knee pain, eight had minor pain and six moderate pain. In 55 patients the patella was centred, seven patellae were slightly shifted or tilted and three patellae were more markedly displaced. One patella dislocated. Six of the patients with the patella in a centred position

suffered from anterior knee pain, and nine had pain associated with shifting, tilting and luxation.

Of 76 patients with patellar replacement 61 had no anterior knee pain, 12 had minor and three moderate pain. In 73 patients the patella was centred, two patellae had a minor tilt and shift, and one marked tilting and shifting. Among 73 patients with a centred patella, 12 complained of anterior knee pain.

In 115 patients with an uncemented femoral component complete radiological osseointegration was observed in 47, whereas 68 showed radiolucency of Type 1 (Fig. 1). In 28 patients with cemented femoral implants radiolucency was only seen in one (Type 1). In 87 uncemented tibial implants 33 showed no radiolucency, 47 showed radiolucency of Type 1 and seven of Type 2. In 56 cemented tibial implants 34 showed no radiolucency and 22 radiolucency of Type 1.

The crews of MG I tibia-implants had Type 0 in 66, Type 1 or Type 2 in 14 and 7 Type 3.

Clinical review and radiographic assessment were carried out in 203 patients with 219 MG II TKAs. The average length of follow-up was 36 months (range: 12–79 months). The HSS score increased from 44 points preoperatively to 85 points after surgery. Average flexion of 106° remained unchanged. Ten revisions were necessary.

Revisions were necessary in 10 cases. The reasons for revision were one early infection, three late infections, two fractures of the tibia plateau, three cases of patellar instability and one knee instability.

In 126 patients without patella replacement 113 were free of anterior knee pain, seven had minor pain and six moderate pain. Radiologically 120 patellae were centred and six had minor shifting and tilting. Seven of the patients with a centred patella reported anterior knee pain. In patients with radiological tilting and shifting three experienced anterior knee pain.

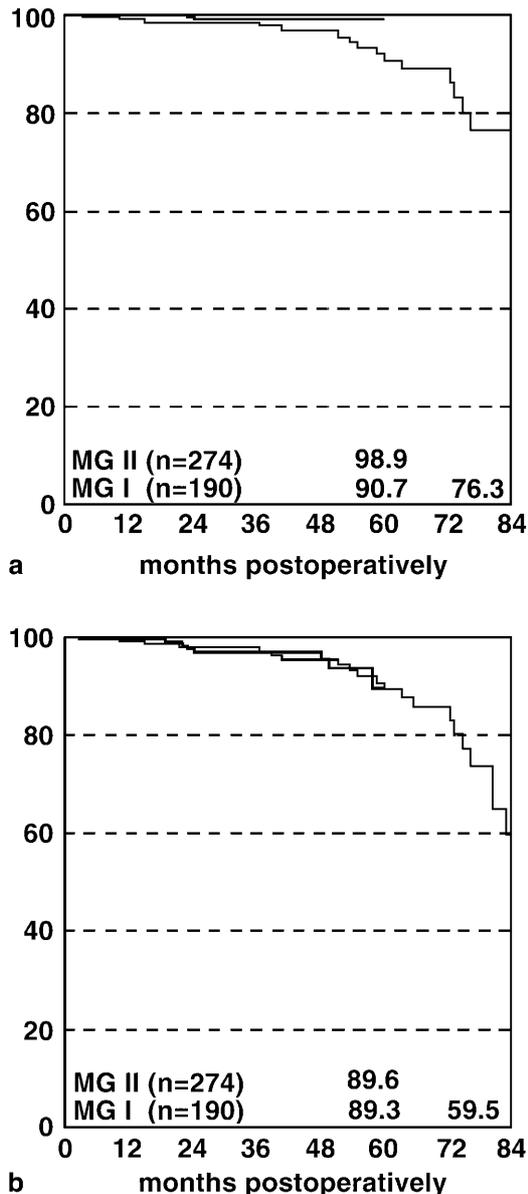
Of 93 patients with patella replacement 86 were pain-free, four had minor pain and three had moderate pain. Ninety of the patellae were centred. Only six patients with patellar centring reported pain whereas nearly one-third of the patients with patellar shifting and lateralisation had pain.

Of 188 patients with an uncemented femoral implant, 168 showed no radiolucency whereas 18 showed radiolucency of Type 1, and two of Type 2. Of the 31 cemented femoral implants only one showed radiolucency (Type 1). Of the 79 uncemented tibial implants 44 showed no radiolucency, 29 Type 1 and six Type 2. Of the 140 cemented tibial implants 99 showed no radiolucency whereas 40 showed radiolucency Type 1, and one radiolucency Type 2 (Fig. 2).

In MG II prostheses, Type 0 around the screws was observed in 65, Type 1 or Type 2 in 13 and Type 3 in 1.

### Survival analysis

The 60-month survival rate for all revisions as endpoint (due to aseptic loosening of femoral and/or tibial compo-



**Fig. 3** Survival (percentage) with revision of the patellar joint or patella component as endpoint. Weakly significant difference between version I and II (logrank-test  $p=0.064$ ) (a). Survival (percentage) with all revisions as endpoint (b)

nents, deep infections) was 89.6% for MG II and 59.5% after 84 months for MG I (Fig. 3).

If only aseptic loosening of femoral and/or tibial components was regarded as implant failure, the MG II showed a 95.7% survival rate after 60 months and MG I 91.5%, and 68.7% after 84 months.

There was a weakly significant difference in survival rates (logrank test  $p=0.064$ ) between MG I and MG II with revisions of the patellar joint as endpoint (change of loosened or fractured patellar component, alignment and resurfacing due to osteoarthritis). MG II proved excellent, with 98.9% survival after 60 months, whilst MG I failed with a rate of 76.4% after 84 months.

## Discussion

In our study a larger number of uncemented MG I prostheses were implanted than in the MG II system. The revision rate for the MG I prosthesis is markedly higher than for the MG II prosthesis. This is primarily caused by the use of the metal-backed patella in the MG I prosthesis. The revision rate of metal-backed patellae is higher in our study than in that of other authors [2, 4, 5, 6, 7, 8, 9]. Moreover, when the indication for implant revision is recognised soon after arthroplasty, femoral destruction and even replacement of the implant can be avoided. Our complication rate with regard to infection and fracture of the tibia plateau was not significantly different from that of other authors [4]. Secondary patellar resurfacing due to patellofemoral instability was more often necessary with the Miller-Galante I system and was usually performed in combination with a soft tissue procedure.

The postoperative HSS score was somewhat better for the Miller-Galante II prosthesis than for the Miller-Galante I prosthesis. Comparable scores reported by other authors for the Miller-Galante I prosthesis were consistently ten points higher [8].

Although slightly higher, the postoperative range of movement was virtually the same for both prostheses and was comparable with those reported by other authors [5].

Both with and without patellar resurfacing there was a marked improvement in anterior knee retro patellar pain. There was only a slight difference between the Miller-Galante II type group with and without patellar resurfacing, and this is comparable with other studies [1]. The frequency of anterior knee pain reported by other authors using the Miller-Galante prosthesis was below 10% [6] and this was lower than in our patients. The radiographs showed that radiolucencies at uncemented femurs occurred very much less often with type MG II, whereas the frequency was mostly the same with cemented prostheses. Radiolucency at the tibia in uncemented prostheses of the MG I type was observed more often than with the MG II. This also applied to cemented prostheses.

When the MG II replacements were implanted without patellar resurfacing, patellar centring was better than with MG I and only 5% were shifted. There were no patellar dislocations. With patellar resurfacing and a cen-

tered patella position there was only a slight difference of pain in favour of the MG II prosthesis.

Patients with Type MG II with and without patellar resurfacing, complained of less pain than with MG I. There was less anterior knee retro patellar pain in spite of the lower rate of retro patellar resurfacing.

In conclusion, the Miller-Galante II system represents an improvement over MG I with regard to revision rate, patellar resurfacing, postoperative HSS score, anterior knee pain, radiolucency at the femur and at the tibia, patellar position without resurfacing and tibial osteolysis.

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