Acta Orthop. Belg., 2010, 76, 613-618

ORIGINAL STUDY

Early experience with the DePuy Proxima™ short stem in total hip arthroplasty

Kálmán TÓTH, László MÉCS, Péter KELLERMANN

From Szent-Györgyi Albert Clinical Center, University of Szeged, Hungary

Bone saving hip athroplasty is a reasonable option for younger active patients, as they are potential candidates for subsequent revision arthroplasty. In this clinical and radiological study we have evaluated our first 41 consecutive cases of total hip arthroplasty including a DePuy Proxima™ short stem. Harris Hip Scores (HHS) were calculated preoperatively, and 6, 12 and 24 months postoperatively. Mean age at surgery was 49 years (range : 35 to 60), mean follow-up was 26 months (range : 13 to 44). Mean Harris Hip scores increased by 39 and 50 points respectively at 6 and 24 months follow-up. No radiological loosening or migration was observed. In carefully selected young patients when resurfacing is contraindicated, use of the Proxima short stem appears as a simple and effective option for THA. However, longer follow–up time is required to analyse the results and to confirm the durability of the observed clinical outcomes.

Key words : short stem ; Proxima ; bone saving ; hip arthroplasty.

INTRODUCTION

Total hip arthroplasty (THA) has become a successful operation for osteoarthritis of the hip in the past half century. The increased need for better quality of life has led to the indication being extended to younger active patients, thus raising the number of revisions as well. Bone loss due to loosening of the traditional stems has resulted in numerous technical difficulties. Shorter stems preserve metaphyseal cancellous bone stock by a more proximal fixation, reducing proximal stress shielding, which gives more chance for a revision surgery with use of a conventional primary stem (*17*). We report our early experience with the Proxima® stem in THA, evaluating our first 41 consecutive cases. Technical aspects of the surgical technique are discussed.

MATERIALS AND METHODS

Forty one Proxima™ (DePuy , Leeds, UK) short stems were implanted since September 2006 in our department. The Proxima stem is made of forged titanium alloy, with a Duofix™ HA (porous coating and hydroxyapatite) surface coating. Nine sizes of standard as well as high-offset stems for each side are available.

Cementless Duraloc™ porous coated cups (Depuy) with 10° lipped polyethylene liners and 28 mm metal heads were used in all cases.

The indication was hip osteoarthritis or avascular necrosis in young and active patients who were not

■ Kálmán Tóth, MD, PhD, Professor of orthopaedic surgery
■ László Mécs, MD, Orthopaedic surgeon
■ Péter Kellermann, MD, PhD, Orthopaedic surgeon
Department of Orthopaedics, Szent-Györgyi Albert Clinical Center, University of Szeged, Hungary
Correspondence : Kálmán Tóth MD, PhD, Department of Orthopaedics, University of Szeged, 6. Semmelweis str., Szeged, Hungary H-6725
E-mail : tothk@orto.szote.u-szeged.hu

No benefits or funds were received in support of this study

appropriate candidates for a resurfacing procedure.

The following elements were considered contraindications to implantation of a Proxima stem : stem size 1 or 2 for patients with body weight over 100 kg, severe hip dysplasia, previous hip osteotomy or other acquired femoral distortion, cortical index less than 3, severe osteoporosis.

The first 41 consecutive procedures were evaluated clinically and radiologically. Twenty four male and eleven female patients were operated on ; one female and five male patients had bilateral surgery in two stages. Mean age of the patients was 49 years (range : 35 to 60 ; SD 8.4) at time of the surgery. Mean follow-up was 26 months (range : 13 to 44 ; SD 13.2). Patients' distribution according to diagnosis was : primary osteoarthritis (OA) in 17, avascular femoral head necrosis in 16, OA with mild dysplasia in 5, post-traumatic OA in 1 and OA secondary to Perthes disease in 1.

All procedures were performed by the same surgeon, in the supine position, through an antero-lateral approach, with minimally invasive technique. Any intra- or postoperative complications were recorded.

The clinical status of the patients was documented with the Harris Hip Score (HHS) (*11*). Low molecular weight heparine was administered for 42 days postoperatively for thromboembolism prophylaxis. Partial weight bearing using crutches was recommended for four weeks post operatively, thereafter full weight bearing with canes was allowed for two additional weeks.

Pre- and post-operative radiographs were taken with identical settings for each patient. Implant migration was assessed according to Martell *et al* (*18*). Implant stability was evaluated according to Engh *et al* (*5*), based on the radiological features of the bone-implant interface. Criteria for radiological loosening of the implant were defined as a radiolucent zone greater than 3 mm, or a horizontal and/or vertical migration greater than 2 mm with an adjacent radiolucent zone (*14*). Stem alignment was rated as normal if its deviation from the axis of the femoral shaft was 5° or less. A deviation of 6 to 10° was rated as "varus" or "valgus" ; a deviation exceeding 10° was rated as "severe varus" or "severe valgus".

RESULTS

Mean preoperative HHS value was 38 (range : 11 to 69 ; SD 13). Mean postoperative HHS was 77 at six months (range : 44 to 94 ; SD 15), 89 at twelve months (range : 53 to 99 ; SD 13) and 88 at twenty four months (range : 53 to 99 ; SD 13.1). We had two complications : an intraoperative fracture was treated by open reduction and fixation with a plate. One patient had dislocation as a result of socket malposition, therefore only the socket's position was adjusted in a revision surgery as the stem had been properly implanted. We did not observe any infection, deep vein thrombosis or pulmonary embolism.

The alignment of the Proxima™ stem on the immediate post-operative radiograph was found to be in severe varus position on two occasions (fig 1) ; eight stems were implanted in varus, and 31 in neutral position. During the follow-up period, no signs of either clinical or radiological loosening were detected.

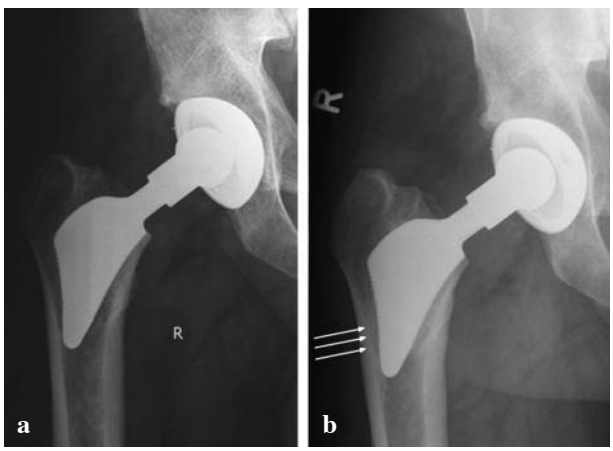

Fig. 1. — Undersized Proxima stem in varus position (a) immediate postoperative radiograph (b) radiograph 24 months post op. Strengthening of the trabecular structure against the lateral aspect of the stem (arrows) can be seen (the patient is clinically symptom-free).

At the latest follow-up examinations, all respondents stated that they would undergo the operative procedure again. Ninety five percent of the patients were completely satisfied with the outcome of the surgery ; the patient who had an intraoperative periprosthetic fracture and the other patient who had a dislocation were satisfied as well.

DISCUSSION

The success of non-cemented total hip arthroplasty relies on osseointegration of the implants. A prerequisite is primary stability, which can be achieved by press fitting (*12,20*). Clinical studies investigating the migration behaviour of femoral components have shown that the failure rate of uncemented stems correlates with migration (*3,7,16*). Sychterz *et al* found that *in vivo* bone loss was most extensive in the proximal medial region (*22*).

Following traditional arthroplasty procedures, bone density measurement has shown a bone loss of 16 to 30 % (*14,21,22*). *Post mortem* investigation by Engh *et al* has found 7 to 52% bone loss around osseointegrated non-cemented femoral components (*6*). DEXA measurements by Kishida *et al* showed that two years after resurfacing procedures, a 12% increase in bone density developed in Gruen zone 7 (*15*).

These findings, along with experience gained from revision surgeries (technical difficulties caused by bone loss due to loosening) and the high cost of a number of revision implants, have led to a change in primary arthroplasty principles toward a more preventive approach. Short-shaft stems have been designed for use in those young and active patients for whom resurfacing of the hip is contraindicated (large avascular necrosis of the head, osteoporosis, obesity, etc.). The very proximal position of these stems leaves the chance for implantation of a non-revision stem during revision surgery. In our department both resurfacing and short-shaft stem are available for young and active patients. Resurfacing is preferred when indication criteria are suitable (*1,2*) ; for the remaining patients a Proxima™ stem is now implanted. This study evaluates the author's experiences with the Proxima™ stems.

The number of cases and the length of follow-up are not extensive enough to draw a final conclusion in comparison to traditional arthroplasty procedures. However, it is sufficient to conclude that this procedure greatly differs ; therefore a number of points may be usefully discussed.

1. Head-neck resection

Attention should be paid to the level of the head-neck resection. A crucial bony surface for fixation of the stem is lost if the cutting plane is more oblique than optimal, i.e. if it is close to the traditional cutting plane. On the medial side the resection should always start at the head-neck junction and run more distally while proceeding laterally, thus creating a wider entrance for the stem (see paragraph 3. below). Ender *et al* have reported in conclusion of a five-year follow-up of 120 CUT® short-stem implantations, that out of the 11 revision cases, seven femoral necks had ben resected either too diagonally (traditionally) or too widely (*4*).

2. Positioning

Inadequate hit force during the "round the corner" broaching can result in a varus position of the stem. As no intramedullary guidance is available for the Proxima stem due to its metaphyseal location, a varus position is more likely to occur, especially when a minimally invasive approach is used, as visualization of the femoral axis is more difficult. It is imperative to perform intraoperative axis measurements during sequential broaching. Until proper experience is acquired the use of fluoroscopy is advisable. Ghera and Pavan reported a study on 65 Proxima™ stem implantations, in which 44 stems were found to be in neutral position, 15 in varus and 6 in valgus (*8*). Gilbert *et al* found that from 34 Mayo® short stems implanted, 14 were neutrally aligned, 19 were in varus, and 11 in valgus position (*9*).

In our study 2 of 41 Proxima™ stems were found to be in severe varus, 8 in varus and 31 in a neutral position, which seems to be comparable with the previous reports.

3. Stem sizing

The "round the corner" broaching technique was developed to save bone stock in the lateral segment of the metaphysis. However, it can happen that the broach of the planned size would not fit into the resected part of the femoral neck (fig 2).

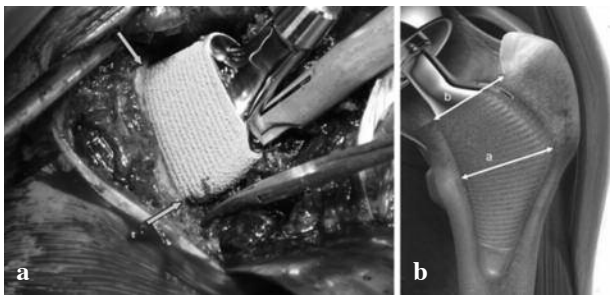

Fig. 2. — Fitting of the Proxima stem into the proximal femoral metaphysis (a) Intraoperative picture ; the cortical bone of the neck is in contact all around with the largest diameter of the stem (arrows) (b) the measured width of the stem (a) is wider than the entrance (b).

In this situation, the following solutions are possible depending on the bone stock quality : When cancellous bone is weak, the neck in the lateral aspect of the resection plane should be gently enlarged until the stem of the desired size can be implanted. An undersized stem in a weak cancellous bone tends to tilt into varus, and may sink deeper than expected. The deep position of the stem then needs to be corrected by a longer neck, which raises the biomechanically disadvantageous torque force on the short stem (fig 1). When cancellous bone is hard, implantation of a Proxima™ stem smaller than the calculated size of the metaphysis is acceptable. Even if the stem does not reach the lateral cortex, the strong and compact cancellous bone can hold the femoral component firmly (fig 3).

4. Cortical index

Proxima™ hip implantation is contraindicated when cortical index (fig 4) scores are less than 3 ; in this situation a cemented stem is advisable. If the cortical index is between 3 and 4, an oversized Proxima™ stem is suggested ; if cortical index exceeds 4, a normal sized Proxima™ stem can be used.

Among the 41 Proxima™ stem implantations, the only intraoperative complication was a spiral femoral shaft fracture. The stem sank deeper into the femoral shaft than the identical sized broach, causing an infraction, which resulted in a complete spiral shaft fracture during the repositioning maneuver. The cortical index of the affected hip was 3.75 ; the mean cortical index of the other cases was 6.07.

In previous reports on short stems, the HHS values showed, after a minimum follow-up period of three-months after operation, an increase of 56 points for the Mayo® stem (*13*), 33 for the CUT® stem (*23*) ; our results showed an increase of 39 points with the Proxima™ stem. At a minimum follow-up time of 12 months, an increase in the HHS of 51 (*4*) and 34 points (*23*) with the CUT® stem, 51 with the Proxima™ (*8*) and 51 (*19*) with the Mayo® stem have been reported ; in this study we noted a 50 points increase in the HHS with the Proxima™ stem one year post operatively. The increase in the HHS presented in this study appears to be in line with previous reports.

Fig. 3. — Antero-posterior and lateral radiographs of a Proxima stem in a hard cancellous bone (a-b) immediately after operation (c-d) 24 months post op. The stem is fixed by cancellous bone, without loosening.

Fig. 4. — Calculation of the cortical index. Cortical index = (10 × (a-b))/a, where a is the outer diameter of the femur and b is the inner diameter of the medullary cavity 10 cm below the level of the lesser trochanter.

Some studies reported a vertical or horizontal (varus) migration of short stems requiring a subsequent revision (*4,23,19*), others described significant radiolucent lines or progressive proximal femoral osteolysis around the short stems without a need for revision (*9,10*). In our study, no horizontal or vertical migration was found at follow-up, not even with the under-sized and varus positioned stem (fig 1).

Thigh pain is a common complaint following non-cemented hip arthroplasty. Among the Proxima™ hip cases evaluated in this study, none of the patients reported any thigh pain ; Ghera and Pavan reported similar findings with Proxima™ stems (*8*). Hube *et al* also did not find any thigh pain following THA with the Mayo® stem (*13*). Other studies reported severe thigh pain following short stem implantation (Mayo®, CUT®), requiring revision (*4,9,23*).

In our experience, implanting a Proxima™ femoral stem is not difficult but is different. In carefully selected young patients, when resurfacing is contraindicated, the implantation of a Proxima™ short stem is a simple and effective method for THA. However, longer follow–up time is required to assess the evolution of the radiological observations and to confirm the durability of the observed clinical outcomes.

REFERENCES

1. **Beaulé PE, Dorey FJ, LeDuff M, Gruen T, Amstutz HC.** Risk factors affecting outcome of metal-on-metal surface arthroplasty of the hip. *Clin Orthop Relat Res* 2004 ; 418 : 87-93.
2. **Daniel J, Pynsent PB, McMinn DJ.** Metal-on-metal resurfacing of the hip in patients under the age of 55 years with osteoarthritis. *J Bone Joint Surg* 2004 ; 86-B : 177-184.
3. **Donnelly WJ, Kobayashi A, Freeman MA *et al*.** Radiological and survival comparison of four methods of fixation of a proximal femoral stem. *J Bone Joint Surg* 1997 ; 79-B : 351-360.
4. **Ender SA, Machner A, Pap G *et al*.** Cementless CUT femoral neck prosthesis : increased rate of aseptic loosening after 5 years. *Acta Orthop* 2007 ; 78 : 616-621.
5. **Engh CA, Bobyn JD, Glassman AH.** Porous-coated hip replacement. The factors governing bone ingrowth, stress shielding, and clinical results. *J Bone Joint Surg* 1987 ; 69-B : 45-55.
6. **Engh CA, McGovern TF, Bobyn JD, Harris WH.** A quantitative evaluation of periprosthetic bone-remodeling after cementless total hip arthroplasty. *J Bone Joint Surg* 1992 ; 74-A : 1009-1020.
7. **Freeman MA, Plante-Bordeneuve P.** Early migration and late aseptic failure of proximal femoral prostheses. *J Bone Joint Surg* 1994 ; 76-B : 432-438.
8. **Ghera S, Pavan L.** The DePuy Proxima hip : a short stem for total hip arthroplasty. Early experience and technical considerations. *Hip Int* 2009 ; 19 : 215-220.
9. **Gilbert RE, Salehi-Bird S, Gallacher PD, Shaylor P.** The Mayo conservative hip : experience from a district general hospital. *Hip Int* 2009 ; 19 : 211-214.
10. **Goebel D, Schulz W.** The Mayo cementless femoral component in active patients with osteoarthritis. *Hip Int* 2009 ; 19 : 206-210.
11. **Harris WH.** Traumatic arthritis of the hip after dislocation and acetabular fractures : treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg* 1969 ; 51-A : 737-755.
12. **Henry JD, Reilly D, Poss R.** Two- to four-year experience with cemented, press-fit, and porous coated applications of the Profile total hip system. *Acta Orthop Belg* 59 Suppl I 1993 ; 190-194.
13. **Hube R, Zaage M, Hein W, Reichel H.** Early functional results with the Mayo-hip, a short stem system with meta-

physeal-intertrochanteric fixation. *Orthopäde* 2004 ; 33 : 1249-1258.

14. **Kim YH, Oh SH, Kim JS.** Primary total hip arthroplasty with a second-generation cementless total hip prosthesis in patients younger than fifty years of age. *J Bone Joint Surg* 2003 ; 85-A : 109-114.
15. **Kishida Y, Sugano N, Nishii T *et al*.** Preservation of the bone mineral density of the femur after surface replacement of the hip. *J Bone Joint Surg* 2004 ; 86-B : 185-189.
16. **Krismer M, Biedermann R, Stöckl B *et al*.** The prediction of failure of the stem in THR by measurement of early migration using EBRA-FCA. Einzel-Bild-Roentgen-Analyse-femoral component analysis. *J Bone Joint Surg* 1999 ; 81-B : 273-280.
17. **Learmonth ID.** Conservative stems in total hip replacement. *Hip Int* 2009 ; 19 : 195-200.
18. **Martell JM, Pierson RH, Jacobs JJ *et al*.** Primary total hip reconstruction with a titanium fiber-coated prosthesis inserted without cement. *J Bone Joint Surg* 1993 ; 75-A : 554-571.
19. **Morrey BF.** Short-stemmed uncemented femoral component for primary hip arthroplasty. *Clin Orthop Relat Res* 1989 ; 249 : 169-175.
20. **Morscher EW, Widmer KH, Bereiter H, Elke R, Schenk R.** Cementless socket fixation based on the ''press-fit'' concept in total hip joint arthroplasty. *Acta Chir Orthop Traumatol Cech* 2002 ; 69 : 8-15.
21. **Schmidt R, Muller L, Kress A *et al*.** A computed tomography assessment of femoral and acetabular bone changes after total hip arthroplasty. *Int Orthop* 2002 ; 26 : 299-302.
22. **Sychterz CJ, Claus AM, Engh CA.** What we have learned about long-term cementless fixation from autopsy retrievals. *Clin Orthop Relat Res* 2002 ; 405 : 79-91.
23. **Thomas W, Lucente L, Mantegna N, Grundei H.** [ESKA (CUT) endoprosthesis.] (in German) *Orthopäde* 2004 ; 11 : 1243-1248.