Total Hip Arthroplasty in Patients over 70 Years of Age

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Purpose. To assess the results of proximally porous-coated uncemented hip arthroplasty in patients over 70.
Materials and methods. Forty-one consecutive Perfecta (Orthomet)® type prostheses were analyzed in 38 patients of a mean age of 74 years. Initial diagnosis was primary osteoarthritis in 92.6% of them. Clinical assessment was carried out on the basis of the Harris Hip Score and reports of thigh pain; quality of life was also studied with the aid of the SF-12 questionnaire. A radiological assessment was made of signs of component incorporation, loosening or displacement and the presence of poly liner wear. Minimum post-op follow-up was 7 years and mean follow-up was 9.4 years.
Results. Mean clinical score at the end of follow-up was 76.6 points. X-ray assessment showed, for the acetabular component, 35 stable cups with bony incorporation (87.5%), 1 stable cup fibrous integration (2.5%) and 4 unstable cups (10%); as regards stems, 35 were stable with bony incorporation (87.5%), 2 were stable with fibrous integration (5%) and 3 were unstable (7.5%). There were 3 prosthetic dislocations, 1 superficial infection and 1 deep infection. Four acetabular components had to be revised. Although there were no stem revisions, 5 instances of loosening were considered failures as far as survivorship was concerned. Following the Kaplan-Meier method, survivorship of arthroplasties at 12.1 years was 73.1% (CI 95%, 92.7-61.8).
Conclusions. In 26.8% a revision was either performed or necessary, and only 73.5% of cases could boast a satisfactory clinical result. Implant failure was mainly related to technical errors at the level of the cup and to poor primary fixation as far as the stem was concerned. We consider that using proximally porous-coated hip prostheses is inappropriate for osteoarthritic patients over 70 years of age.

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La artroplastia total de cadera porosa en pacientes mayores de 70 años

Objetivo. Evaluar el resultado de la artroplastia total de cadera no cementada con recubrimiento poroso proximal en pacientes mayores de 70 años.
Material y método. Se estudiaron 41 prótesis tipo Perfecta (Orthomet®) consecutivas en 38 pacientes con edad media de 74 años. El diagnóstico inicial fue artrosis primaria en el 92,6%. Para la valoración clínica se emplearon la escala de Harris, la presencia de dolor en el muslo y la calidad de vida según cuestionario SF-12. Radiológicamente se valoraron los signos de integración o aflojamiento de los componentes, la variación en sus posiciones y la evidencia de desgaste del núcleo de polietileno. El seguimiento postoperatorio mínimo fue de 7 años y el medio de 9,4 años.
Resultados. La puntuación clínica media fue de 76,6 al final del seguimiento. La valoración radiológica mostró a nivel del cotilo 35 estables con integración ósea (87,5%), 1 estable con integración fibrosa (2,5%) y 4 inestables (10%); a nivel del vástago 35 estables con integración ósea (87,5%), 2 estables con integración fibrosa (5%) y 3 inestables (7,5%). Hubo 3 luxaciones protésicas, 1 infección superficial y 1 infección profunda. Se revisaron 4 componentes acetabulares. Aunque no hubo revisiones del vástago, 5 casos de aflojamiento se consideraron fallos a efectos de supervivencia. Según el método de Kaplan-Meier, la supervivencia de la artroplastia a los 12,1 años fue del 73,1% (IC 95%, 92,7-61,8).
Conclusiones. En un 26,8% hubo revisión o necesidad de ella, y sólo el 73,5% de los casos presentaban un resultado clínico satisfactorio. Los fallos del implante se relacionaron principalmente con un defecto de la técnica a nivel del cotilo y a la mala fijación primaria a nivel del vástago. Consideramos inadecuada la utilización de prótesis de cadera con recubrimiento poroso proximal en pacientes artrósicos de más de 70 años.

Palabras clave: *cadera, artroplastia total no cementada, recubrimiento poroso proximal.*

The satisfactory result of non-cemented total hip replacement with porous coating has been widely reflected in the literature[1-7]. The reasons for this good result are the firm fixation of the implant based on the design of the components and the placement technique, which has a protective effect on particle migration due to wear since there is greater osteointegration and less periprosthetic bone resorbtion[1,2,8]. Although some consider that osteointegration is only effective if there is bone of adequate quality[9] present.

The life expectancy of the Spanish population has increased progressively in the last decades. Therefore, total hip replacement in elderly patients in good physical condition with acceptable bone quality is ever more frequent. The aim of this procedure is to significantly improve hip functionality and quality of life for the patient, and, ultimately, increase life expectancy.

The purpose of our work is to assess the clinical and radiological results of non-cemented total hip replacement in patients over 70 years of age with a minimum postoperative followup of 7 years.

MATERIALS AND METHODS

Between 1993 and 1997 our service implanted 78 non-cemented total hip replacements with porous coating in 74 patients of ? 70 years of age.

Inclusion criteria were: no associated inflammatory or metabolic bone diseases, tumors, neurovascular alterations of the affected limb, nor previous hip surgeries. Further inclusion criteria were: an adequate level of daily living activities, social independence and autonomous mobility with or without the help of a walking stick. Bone quality was not taken into account as exclusion criteria. For assessment purposes a minimum follow-up of 7 years was used.

For the current study, patients were given appointments for clinical and radiological exams between January and May 2005; 18 did not come in and another 18 had died after the third postoperative year without requiring surgical revision up to that moment. The final study group comprised a total of 41 arthroplasties in 38 patients. They were 21 men and 17 women with a mean age of 74 years of age (range 70–84 years). The most frequently operated hip was the right one in 22 patients.

The initial diagnosis was primary arthritis in 38 cases, osteonecrosis in 2 and a subcapital femoral fracture in 1 case. During the preoperative period, the mean score of functional assessment according to the Harris[10] scale was 47.4 points (range 40 to 55). Similarly to the method used by other authors, bone quality was assessed by means of an anteroposterior X-ray of the pelvis using the calcar-cortical[1,11,12] index and classifying bone quality as type A if the rate was less than 0.5, 4 cases (9.7%); type B if it was between 0.51 and 0.74, 28 cases (68.2%); and type C if it was greater than 0.75, 9 cases (22.1%).

The model implanted was a Perfecta (Orthomet®, Minneapolis) total hip prosthesis, with an anatomic titanium alloy femoral stem with porous coating on its proximal third and a hemispheric cup with complete porous coating, fins and the option of 4 holes for screws (Figure 1). The friction pair was in all cases metal-high molecular weight polyethylene (Duramer®) sterilized with gamma rays, with a 28 mm chromium-cobalt head.

The size of the femoral stem was that of the last burr used on the metaphysis and considered adequate for a *press-fit* of an appropriate size of the 7 available (range 9 to 18 mm), the most used was the 12 mm size in 16 cases (39%).

The size of the cup, always impacted, was that of the last burr used, and the most frequently used was the 52 mm size in 14 cases (34.1%).It was screwed in in 36 cases (87.8%), according to the state of the bony bed and the surgeon's preference, and always with 2 diverging screws in the upper quadrant.

All patients were operated using the Hardinge approach. Antibiotic and antithrombotic prophylaxis were applied using the service protocol.

Patients were assessed postoperatively according to protocol for at least 3 years without any losses to follow-up up and were then given appointments for follow-up at least 7 years following surgery. Mean follow-up in these patients was 9.4 years (minimum 7 years, maximum 12.3 years).

Postoperatively, clinical assessment was carried out according to the scale, Thigh pain was recorded according to the subscale for pain in the Harris scale. Postoperative quality of life perceived by the patient was assessed by means of a health questionnaire, SF-1213, validated in Spanish, with 12 questions on everyday activities, each one valued at 1 to 5 points from best to worst, with a score considered excellent if it was under24 points.

The postoperative radiological study was carried out with AP hip X-rays to determine signs of integration or loosening of components, position variation and evidence of wear of the polyethylene nucleus. In the acetabular cup, variation of the acetabular tilt angle was assessed and the presence of radiolucent lines or implant migration.

Implants were classified as a) stable with osseous integration if there were no radiolucent lines or migration; b) stable with fibrous integration if there were non-progressive radiolucent lines of less than 1 mm without migration; and c) unstable if the radiolucent lines were progressive or there was component migration. The presence of polyethylene wear was analyzed[15] measuring the distance from the femoral head to the acetabulum and considering that there was significant wear when the difference between two measurements was greater than 2 mm. Engh[16] criteria for non-cemented stems was used for stems and these were classi-

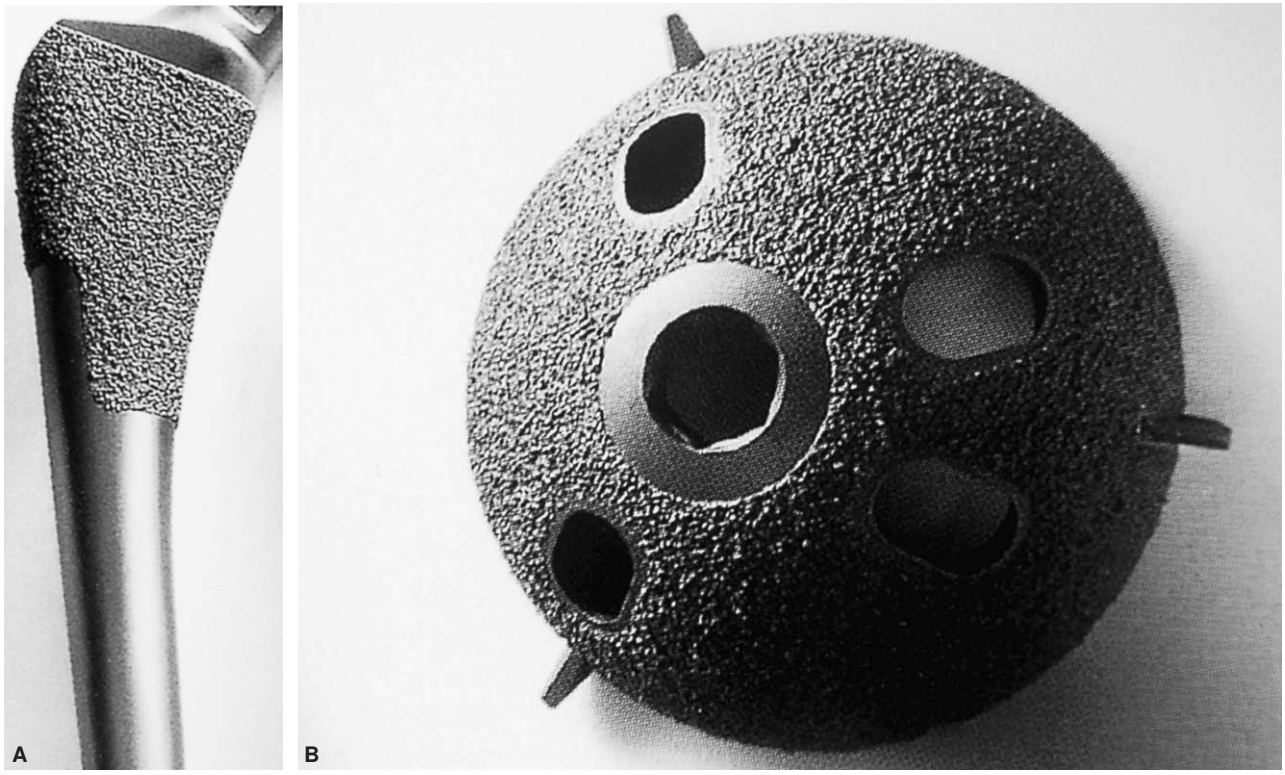

Figure 1. *Perfecta (Orthomet®) porous hip prosthetic components: (A) femoral stem; (B) cup.*

fied as: a) stable with osseous integration when there were no radiolucent lines, no pedestal and when there were points of union in the distal zone of the porous surface (Figure 2); b) stable with fibrous integration when there was a non-progressive radiolucent line of 1 mm surrounding the prosthesis, no union points and a small pedestal; and c) unstable when there was a distal pedestal, calcar hypertrophy, progressive radiolucent lines or clear component migration.

For statistical assessment of the results an IT package, SPSS, was used, and the statistical tests chi square and Spearman's correlation coefficient. For arthroplasty survival analysis the Kaplan-Meier method was used, the endpoint was surgical revision for any reason, and if this is not carried out the date on which the need was determined for any reason. Values of $p \leq 0.05$ were considered significant.

RESULTS

Functional assessment using the Harris[10] scale increased significantly ($p = 0.001$) in the last review to a mean score of 76.6 (range 45 to 95), and was considered excellent in 7 hips (17.0%), good in 24 (58.3%), fair in 2 (4.8%) and bad in 8 (19.9%).

The 2 'fair' cases were due to femoral stem fixation failures with non-progressive radiolucent lines and thigh pain. The 'poor' cases were 4 cases that required cup revi-

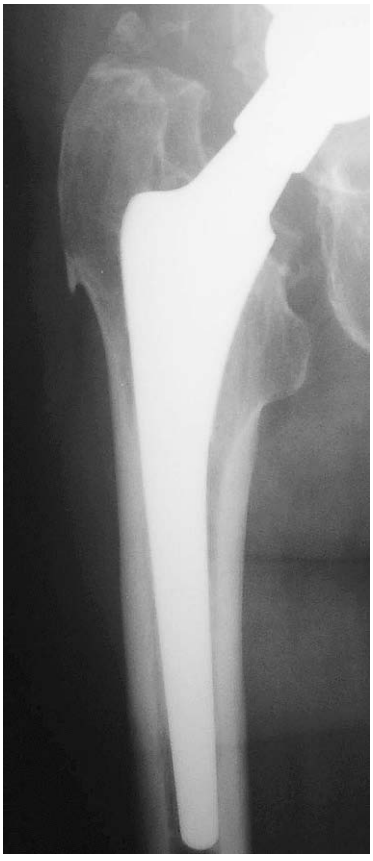

Figure 2. *Anteroposterior X-ray of the hip showing a stem with proximal osteointegration and a union line in the shaft.*

sion surgery, 3 cases with subsidence or stem fixation failure with progressive radiolucent lines and thigh pain and 1 case of reoperation due to deep infection.

Thigh pain was present in 6 cases, in 1 case it was continuous, in 4 moderate, and in 1 slight and it did not limit daily activities. There was a significant association ($p = 0.01$) between continuous or moderate pain and femoral stem instability; in the cases of slight pain the stem was radiologically stable. With reference to postoperative questionnaire SF-12, the mean score was 29.5 (range 14 to 51).

The 14 patients (38.6%) with good quality of life (score under 24 points) had not developed medical pathological conditions during the postoperative follow-up, nor associated mechanical failure or complications due to prosthetic surgery. The cause of deterioration in quality of life (score over 24 points) in the remaining 24 patients (61.4%) was the development of pathological medical conditions during the second half of the postoperative follow-up in 14 patients (cardiorespiratory in 12 and neurological in 2), and mechanical failure and consequent complications of prosthetic surgery in 10 patients. A significant correlation was found between postoperative assessment with SF-12 and assessment with the Harris scale both preoperative, ($r = –0.640$; $p = 0.001$) and postoperative ($r = –0.432$; $p = 0.011$).

Radiologically, in the last review 87.5% (35 cases) of the cups were stable with osseous integration, 2.5% (1 case) were stable with fibrous integration and 10% (4 cases) were unstable.

The acetabular tilt angle (ATA) had a mean value of 42.5° (range 35° to 88°), was correct in 37 cases (90%) and in 4 cases (10%), all with a calcar type B index, verticalized (range ATA between 56° and 88°). Of these last cases, one case with an ATA of 56° had a stable cup with osseous integration and a final clinical score of 76 and another case with an ATA of 60°, a stable cup with fibrous integration and a score of 72, therefore surgical revision was not indicated in any of them; another 2 cases, with an ATA of 62° and 88°, presented cup migration with polyethylene wear and progressive pain: Surgical revision was carried out at in these 44 and 65 months after primary surgery.

One case with a correctly tilted cup (ATA 41°), with a calcar-cortical type index of A, presented dislocation in the immediate postoperative period which was reduced conservatively, but at 88 months the patient presented with an unstable cup with radiolucencies in zone II and a sudden polyethylene breakage, thus requiring surgical revision (Figure 3). Another case had 2 dislocation episodes and required cup replacement due to excessive anteversion. Radiologically, with relation to the femoral stem 87.5% (35 cases) of the implants were stable with bone integration, 5% (2 cases) were stable with fibrous integration and 7.5% (3 cases) were unstable at the end of followup.

No changes in angle tilt were detected during follow-up but in 2 cases, both with a type C calcar-cortical index, there was stem subsidence at 8 and 14 months after surgery with a poor clinical result. Therefore, although they did not require surgical revision, they were considered failures as far as arthroplasty survival.

Another case, with a type C calcar-cortical index, presented progressive radiolucencies and a poor functional result, and another 2 cases, type B calcar-cortical index, presented non-progressive radiolucencies with fair results; therefore all 3 required revision and were considered failures as far as implant survival. A third, that is 33.3% of patients with type C calcar-cortical index had associated mechanical failure of the femoral stem, compared with 7.1% of type B cases ($p = 0.01$).

Intraoperative complications seen: a calcar fracture treated with wiring without necessity of suspending loadbearing, with a good functional final result. In the perioperative period there were 3 cases of prosthesis dislocation that were reduced conservatively, one with excellent clinical results and the other 2 cases already mentioned that required cup revision. There was a case of superficial infection treated by cleaning and antibiotics, with complete resolution of the process and good clinical results, and another case of a deep infection 8 months after surgery in which the implant was extracted, and the patient rejected a second surgery to place a new one. In summary, surgical revision of the acetabular cup was carried out in 4 cases; although stem revision was not carried out, its need was analyzed. Therefore there were 5 failures and the above mentioned removal due to deep infection. Therefore, according to the Kaplan-Meier method, arthroplasty survival due to any cause was 73.1% at 12.1 years (Figure 4).

DISCUSSION

Reduced osteogenic capacity in patients of advanced age has been used as an argument to reserve non-cemented prosthesis for younger patients. Implant osteointegration is defined as the direct contact between viable bone and implant, without any interposed soft connective tissue. Engh et al[16] observed bone invasion not greater than 35% of the porous surface in stems extracted from 8 autopsies of cases with a mean age of 73 years and indicated that this could be sufficient to achieve good fixation and satisfactory clinical results. On the other hand, Dorr et al[3] report that femoral implant fixation is not appropriate in patients over 65 years of age and obtain better results with total cemented arthroplasties.

In our series of patients of over 70 years of age at 9.4 years of mean postoperative follow-up, clinical results were only excellent to good in 73.5%. We have found an association between non-satisfactory results and several factors such as mechanical failure of the femoral stem, technical defect in the placement of the acetabular cup, polyethylene

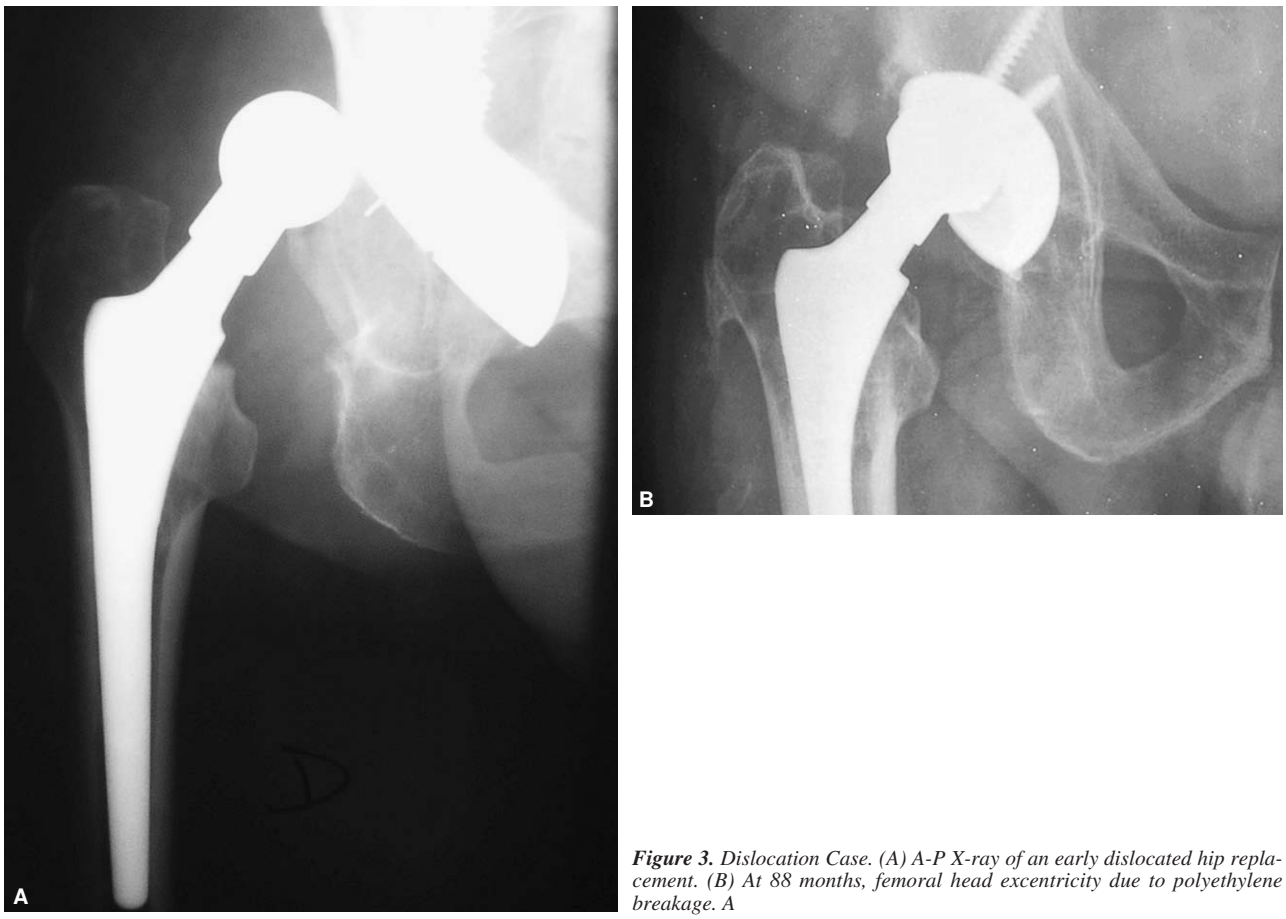

Figure 3. *Dislocation Case. (A) A-P X-ray of an early dislocated hip replacement. (B) At 88 months, femoral head excentricity due to polyethylene breakage. A*

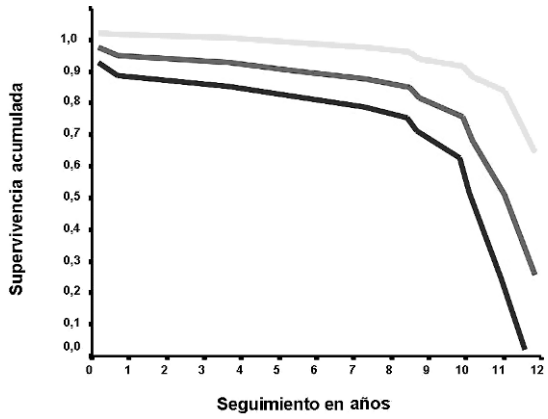

Figure 4. *Cemented replacement prosthesis survival with a 95% CI (Kaplan-Meier).*

wear and deep infection. Dorr et al[3] obtained a mean score of 89.8 points in the Harris scale in a series of 49 non-cemented total hip replacements with first generation stems (APR-I, Intermedics Orthopedics, Austin, TX), in patients with a mean age of 71.2 years of age and a mean followup of 6.2 years; although 9 patients (18.3%) had stem loosening and 1 patient (2.0%) a deep infection. On the other hand, Oosterbos et al[4] in 100 patients with non-cemented total hip replacements with second generation stems (ABG, Stryker, Newbury, England) and patients with a mean age of 72 years of age, reported a mean score of 17 according to the Merle d'Aubigne scale, requiring the revision of 1 stem (1%) and 3 acetabular cups (3%) at 10 years of follow-up.

The SF-12 questionnaire is practical, feasible, valid and sensitive to clinical changes over time[13]. In our series the preoperative condition of the patient has significantly influenced final quality of life, with a significant correlation of the preoperative Harris scale and the SF_12 questionnaire. Furthermore, the deterioration of the patient's quality of life was not only due to mechanical failure of the arthroplasty or complications caused by surgery. Of the total, 58.3% of the patients with a score greater than 12 points in the SF-12 questionnaire developed medical pathological conditions during the postoperative period, mainly cardiorespiratory conditions, but with radiologically stable prosthesis. However, Dorr et al[3] in their study always related arthroplasty mechanical failure with the deterioration of the patient's activities. Thigh pain has been related to level of activity, femoral stem design or its stability.

Some authors report an incidence of up to 36% with a follow-up of 12 years[4]. Although the series with titanium

stems report an incidence of 2-9%[1,2,5], other authors report an incidence of 1% with chromium-cobalt and follow-ups of 11 years[17]. In our series, the incidence of moderate-severe pain has been 12.5% and all cases were associated with the radiological presence of unstable stems, which was related to bone quality, since incidence was significantly higher in type C calcar-cortical index cases.

The hemispheric acetabular cup design showed the best results with follow-ups of 10 to 18 years and prosthesis survival of 75 to 99%[7,18,19], similar to our series with 87.5% although with a shorter follow-up. In this study impacted acetabular cups were threaded n most cases. The use of screws is recommended in osteoporotic patients, in cup displasia or when there are reasons to doubt implant stability at the time of placement. The *press-fit* technique has achieved similar survival rates without the need for screws, which seems to be a protective factor as far as the appearance of radiolucent lines and periacetabular osteolysis[20], although other authors relate this process to polyethylene wear, and therefore continue to advise the use of screws[7,19]. In our series, we have not seen osteolysis not wear directly related to the placement of acetabular screws.

Polyethylene wear is influenced by biological factors such as age, component design factors and technical factors. All authors coincide that polyethylene wear is more frequent in patients under50 years of age, due to a greater functional demand[14,19,21], whereas in patients over 70 years of age annual polyethylene wear is reduced in 64%[20]. Chromium-cobalt heads of 28 mm present acceptable polyethylene wear, although the current trend is a demand for friction pairs with less wear to obtain better results[15]. The acetabular tilt angle (ATA) has a direct relationship with polyethylene wear. Wear doubles if the ATA is greater than 50°[14,15,19-21]. In our series, 75% of the patients in which acetabular cups were placed with an ATA greater than 50° showed wear of the associated polyethylene. The case of sudden polyethylene breakage had a correct ATA, although there was a history of immediate postoperative dislocation treated by closed reduction.

Femoral stem survival has been 87.5%, less than in other published series of second generation stem revision with follow-ups of 5 and 10 years, and prosthesis survival of 92.5 to 100%[1,2,5,7,22]; but in all studies mean patient age was under 70.. In our study stem mechanical failure has shown a significant association with preoperative bone quality.

According to our results 87.8% of patients still had the original implant at 9.4 years of mean followup, although only 73.5% of the patients presented satisfactory clinical results. The development of pathological medical conditions during followup directly influenced the deterioration of the patient's quality of life. Implant failures were mainly related to a defective technique in cup implantation and a defect in primary fixation of the stem, especially in patients with worse bone quality. Therefore we consider that non-cemented total hip replacement with porous coating has a high rate of integration and functional failures in patients over 70 years of age with arthritis.

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