Cementless acetabular component without screw holes with immediate full weightbearing

a minimum 20-year follow-up study

From Queen Mary Hospital, The University of Hong Kong, Hong Kong, China

Correspondence should be sent to L. C. M. Lau laucml@hku.hk

Cite this article:
Bone Jt Open 2025;6(5 Supple A):
14–21.

DOI: 10.1302/2633-1462.65.BJO-2024-0197.R1

L. C. M. Lau,[1] K. Y. Wong,[2] H. Hu,[2] M. H. Cheung,[1] F. Y. Ng,[1] H. Fu,[1] P. K. Chan,[1] K. Y. Chiu[1]

[1]Department of Orthopaedics and Traumatology, School of Clinical Medicine, The University of Hong Kong, Hong Kong, China
[2]Department of Applied Mathematics, The Hong Kong Polytechnic University, Hong Kong, China

Aims

This study aimed to evaluate the survival of a cementless component without screw holes in total hip arthroplasty (THA) at a minimum follow-up of 20 years. This design has the benefits of maximizing bone contact and reducing osteolysis by eliminating channels to backside wear. However, transacetabular screws cannot be used.

Methods

A total of 71 hips in 58 patients receiving the same model of cementless component without screw holes (Depuy Duraloc 100 hydroxyapatite (HA) component) from June 1999 to March 2003 were prospectively followed up. All patients were allowed to have immediate full weightbearing. The mean age at THA was 53.7 years (28 to 74). Osteonecrosis was the leading cause of THA. Survival was assessed with any revision and component revision as the endpoint. Radiological parameters, including lateral opening angle, and the components' vertical and horizontal migration distances, were measured and compared between the early postoperative period and final follow-up.

Results

Overall, 54 hips were assessed at a minimum 20-year follow-up. The mean follow-up was 22.9 years (20.9 to 24.5). Two component revisions occurred at 17.5 and 17.6 years later. Both components were well fixed but were revised, due to the need to upsize the articulation and component malpositioning, respectively. Conventional polyethylene (PE) was used in both hips, and 14 other hips were revised with the components well fixed and not revised. The estimated survival of the acetabular component and THA at 20 years was 96.4% and 74.5%, respectively. Mean changes in lateral opening angle and vertical and horizontal migration distances were 0.48° (SD 1.45°), -0.06 mm (SD 1.44), and -0.36 mm (SD 1.36), respectively, with no statistical significance.

Conclusion

This study provides evidence of excellent long-term survival of cementless components without screw holes. Immediate postoperative weightbearing did not lead to component migration in the long term.

Take home message

- This study provides evidence of excellent long-term survival of cementless components without screw holes.
- Immediate postoperative weightbearing did not lead to component migration in the long term.

Introduction

Cementless acetabular component in primary total hip arthroplasty (THA) has achieved satisfactory long-term survival.[1,2] However, one of the controversies in cementless components is whether supplementary screw fixation is needed when press-fit is achieved; many modern component designs do provide screw hole options for supplementary screw fixation. Not inserting screws can shorten operating time and avoid the risk of damaging neurovascular structures such as the external iliac vessels. Eliminating these screw holes in the component also has several advantages.[3] Firstly, host-bone contact of the acetabular component is maximized with a larger surface for osseointegration. Secondly, channels between the insert-side and acetabular side of the acetabular component are eliminated, reducing effective joint space for polyethylene (PE) particles and pelvic osteolysis.[4] Thirdly, fretting wear between the component and screw or abrasive wear between the protruded screw head and PE inserts are avoided. The obvious downside is that these components cannot add screws to increase stability, which may be pivotal before osseointegration takes place.

To clarify this matter, we previously published a study in which a patient cohort was inserted with a cementless component (Duraloc 100 (DePuy Synthes, USA)) not designed for screw insertion and allowed to have immediate weightbearing after operations, the latter being another controversy of cementless THA as immediate weightbearing may jeopardize the stability before osseointegration occurs.[3] This Duraloc series has been available since the 1990s, and was ranked the fifth most common choice of component in the 2000s in the Australian registry.[5] Our previous study demonstrated no migration of the cementless component under these two conditions at early follow-up.[3] However, a recent meta-analysis suggested that "the efficacy of acetabular components without screw fixation in total hip arthroplasty remains uncertain."[6] This conclusion was drawn based on four randomized controlled trials with a limited sample size (17 to 35 per group) and limited follow-up period (average 4.85 years, range 2 to 14 years). Despite the method of inserting acetabular components without screw fixation being commonly practised nowadays, there are a lack of long-term data to support its usage.

By following up on our reported case series of 58 patients who had operations between June 1999 to March 2003, we report here the long-term result (survival, radiological findings, and factors associated with revision) of this cohort having cementless components without screws with immediate weightbearing after operations at a minimum follow-up of 20 years, and hypothesize a good survival.[3]

Methods

The early results of this cohort (74 hips in 61 patients) have been published, and the present study reported the follow-up of this cohort with approval from the institutional review board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster (HKU/HA HKW IRB), in accordance with the Declaration of Helsinki.[3] We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines, and a STROBE checklist is included in the Supplementary Material. Three hips in three patients were excluded because they defaulted to follow-up soon after the last follow-up in our last publication. A total of 71 hips in 58 patients continued their follow-up. There were 28 male and 30 female patients, with a mean age at the time of surgery of 53.7 years (SD 12.0, 28 to 74). They were all Chinese, with a mean Charlson Comorbidity Index of 1.2 (SD 1.0, 0 to 4).[7] There were 39 left THAs and 32 right THAs. The indications for surgery were: 33 avascular necrosis (13 alcoholic, eight steroid-induced, nine idiopathic, three post-traumatic); 12 osteoarthritis (ten primary, one secondary to trauma, one secondary to old Perthes' disease); eight ankylosing spondylitis; six developmental dysplasia; three rheumatoid arthritis; four post-trauma (one failed internal fixation for proximal femoral fracture, three failed hemiarthroplasty for femoral neck fractures); four epiphyseal dysplasia; and one old hip tuberculosis. The available sizes ranged from 48 to 60 mm with 2 mm increments. The femoral stems were cemented in 50 hips (48 Elite plus (DePuy Synthes) and two Option 3000 (Mathys, Switzerland)), and cementless in 21 hips (16 Replica A (DePuy Synthes) and five Summit (DePuy Synthes)). The Duraloc 100 Polished HA acetabular component series used were sub-hemispherical, porous-coated, cementless components without screw holes, stabilizing spikes, or pegs. They were inserted with and solely stabilized initially by press-fit technique. The apex holes were plugged and completely occluded the acetabular fixation interface from the PE wear debris.

Five orthopaedic surgeons (KYC, FYN, see Acknowledgements) specializing in arthroplasty in an academic unit employed standardized surgical techniques with lateral position and posterior approach for every patient. The acetabulum was prepared with even-diameter reamers until reaching healthy bone, and then tested with a trial component of the same size as the last reamer. A prosthesis 2 mm larger than the trial component was used to achieve press-fit stability, or a final touching up with an odd-diameter reamer that was 1 mm smaller than the prosthesis might be performed in sclerotic bone. If the stability of the trial was suboptimal, further reaming was done to enlarge or deepen it. We allowed all patients to bear full weight on walking immediately after the surgery (putting 100% body weight on lower limbs the next day when physiotherapy started). They followed a standardized physiotherapy protocol that focused on mobility training and range of motion exercise with hip precautions in the early phase, and muscle strengthening and activity of daily living training in the latter phase.

Statistical analysis

For survival analysis, the Kaplan-Meier estimator was used to estimate the distribution of time to revision, with death and lost to follow-up treated as censoring. A competing risk analysis was also performed, and we estimated the cumulative incidence function with death treated as a competing risk. For radiological analysis, the same measurement methods (Massin et al[8] and Martell et al[9]) employed in our previous publication for component position and radiolucency were used for comparison.[3] Component lateral opening angle was measured as the angle subtended by the inter-teardrops line and a line joining the corners (superolateral/inferomedial) of the component. Horizontal and vertical distances from the teardrop base to the midpoint of the latter line were measured. Component migration was defined as a lateral opening

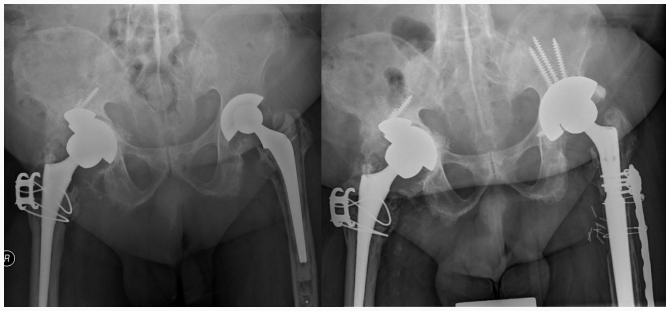

Fig. 1
This 56-year-old male patient's pre-revision pelvic radiograph (anteroposterior view) (left) showed stem loosening and polyethylene (PE) wear, but no acetabular component loosening. The one-month post-revision pelvic radiograph (anteroposterior view) (right) showed that the articulation had been upsized, and the original component was replaced by a larger component.

Fig. 2
This 61-year-old male patient's pre-revision pelvic radiograph (anteroposterior view) (left) showed that there was polyethylene (PE) wear, and the component was of suboptimal positioning with a lateral opening angle of 70°. It was found to be well-fixed intraoperatively, and a column fracture had resulted during the removal process and required additional plate fixation. The one-month post-revision pelvic radiograph (anteroposterior view) (right) showed a new component with plate fixation.

angle of more than 8° change or component position of over 3 mm difference.[8] Prosthesis-bone interface was divided into five zones to describe radiolucency (lateral one-third zone of DeLee and Charnley as A1 and A2; superomedial quadrant as B1 and B2; and inferomedial part as C).[9] The zone in which the gap or radiolucent line occurred was recorded with the width of the gap/line. Radiological measurements between the early postoperative period and latest follow-up were compared. The Wilcoxon signed-rank test was used to compare the changes in lateral opening angle, vertical distance, and horizontal distance of the midpoint of acetabulum from the teardrop.[3,8]

For analysis of the association between individual factors and the time to revision, the log-rank test was used, where continuous factors were dichotomized based on whether the value was larger or smaller than the median. The Cox proportional hazards model was used to characterize the joint effects of multiple factors on the time to revision. Statistical analysis was performed using R statistical software 4.3.3 (R Foundation for Statistical Computing, Austria). A p-value < 0.05 was considered to be statistically significant. All hypothesis tests were two-sided.

Results

In our cohort of 71 hips in 58 patients, 13 patients (17 hips) died of unrelated causes before 20 years. Consequently, 54 hips (45 patients) were assessed over a minimum of 20 years' follow-up. The mean follow-up duration was 22.9 years (SD 0.9, 20.9 to 24.5).

The mean lateral opening angle was 47.4° in the early postoperative radiographs (SD 7.9, 27 to 70) and 47.7° (SD 7.9, 28 to 70) in the final follow-up radiographs. For those who were followed up for more than 20 years, there was no statistically significant change in the lateral abduction angle (mean change 0.48° (SD 1.45, -2 to 5); p = 0.120, Wilcoxon signed-rank test). Regarding the positions of the acetabular components, there was no statistically significant change in the vertical distance (mean change -0.06 mm (SD 1.44, -2.75 to 2.79); p = 0.618, Wilcoxon signed-rank test) or the horizontal distance (mean change -0.36 mm (SD 1.36, -2.87 to 2.78); p = 0.078, Wilcoxon signed-rank test).

A total of two acetabular components were revised but not due to loosening. The first case of acetabulum component revision occurred 17.5 years after the initial operation when stem loosening and PE wear were found. Articulation was upsized for better stability despite the component being stable intraoperatively, and so the component was revised to a larger one to accommodate a larger hip ball. The preoperative radiograph showed that there was stem loosening and PE wear, but no component loosening, and the postoperative radiograph showed upsized articulation (Figure 1, patient 8 of Table I). The second case of acetabular component revision occurred 17.6 years after the initial operation when it was found that there was PE wear, and the component was of suboptimal positioning with an opening angle of 70° and peripheral osteolysis. We found that the component was well-fixed despite peripheral osteolysis intraoperatively. However, we decided to revise the component as its positioning may jeopardize the survival of subsequent PE. The component was so well-fixed that a column fracture resulted during removal and required plate fixation (Figure 2, patient 7 of Table I).

Overall, the probability of not having revision of the acetabular component at 20 years was 96.4% (95% CI 91.8 to 100) (Figures 3 and 4). Using component revision due to loosening as an event, the proportion of not having revision was 100%. There were ten cases (seven Elite plus stems, two Option 3000 stems, and one Replica A stem) with loosening of stem and PE wear and managed with liner exchange and stem revision. There were five cases of isolated PE wear that were managed with liner exchange. In total, 16 THAs had undergone revision surgeries, and all were using conventional PE (Table I). The estimated probability of not having any revision of THA at 20 years was 74.5% (95% CI 64.3 to 86.3) (Figures 4 and 5). Other than an absolute association of conventional PE with revision, the log-rank test showed that overall revision risk was marginally significantly associated with young age (p = 0.044) and AVN (p = 0.044), but not sex, abduction angle, component diameter, and cemented stem. However, these factors had no significant associations in the Cox regression with all the above-mentioned covariates in the model. Only one THA with a gap of 1.1 mm at zone B2 was reported in our previous publication,[3] but the gap was not observable

Table I. Detailed data on revision surgery patients.

Patient no.	First OT age, yrs	Sex	Side	Original diagnosis	Cause for revision	Revision surgery	Original stem	Interval between first and revision surgery, yrs	Original OT date, mth/yr
1	58	M	L	AVN	PE wear	Liner exchange	Elite-Plus	18.08	7/2000
2	50	M	R	AS	PE wear & stem loosening	Linear exchange & stem revision	Elite-Plus	8.75	9/2001
3	37	F	R	RA	PE wear & stem loosening	Linear exchange & stem revision	Elite-Plus	8.08	7/1999
4	50	M	R	AVN	PE wear	Liner exchange	Replica A	15	6/2001
4	50	M	L	AVN	PE wear & stem loosening	Linear exchange & stem revision	Elite-Plus	19	8/2001
5	48	M	L	AVN	PE wear & stem loosening	Linear exchange & stem revision	Option 3000	6.5	1/2000
5	48	M	R	AVN	PE wear & stem loosening	Linear exchange & stem revision	Option 3000	6.42	4/2000
6	55	F	L	DDH	PE wear	Liner exchange	Elite-Plus	7.92	9/2001
7	44	M	L	AS	PE wear & suspected component loosening	Linear exchange & component revision	Elite-Plus	17.6	11/2000
8	39	M	L	AS	PE wear & stem loosening	Linear exchange, stem revision, & component revision	Elite-Plus	17.5	2/2000
9	59	F	L	AVN	PE wear	Liner exchange	Elite-Plus	14.7	3/2001
10	48	M	L	AVN	PE wear	Liner exchange	Elite-Plus	14.1	12/2000
11	47	F	R	AVN	PE wear & stem loosening	Linear exchange & stem revision	Elite-Plus	10.1	11/2000
12	67	M	L	AVN	PE wear & stem loosening	Linear exchange & stem revision	Elite-Plus	11.4	12/2000
13	60	F	R	AVN	PE wear & stem loosening	Linear exchange & stem revision	Elite-Plus	11.6	2/2000
14	40	M	R	AVN	PE wear & stem loosening	Linear exchange & stem revision	Replica A	15.2	11/1999

AS, ankylosing spondylitis; AVN, avascular necrosis; DDH, developmental dysplasia of hip; F, female; L, left; M, male; OT, operation; PE, polyethylene; R, right; RA, rheumatoid arthritis.

subsequently. Two cases (patients 6 and 7 of Table I) developed 5 mm and 4 mm width peripheral osteolysis over zones A1 and A, while the remaining cases had no observable gap or radiolucency between components and host bone. Figure 6 shows the estimated cumulative incidence function for the time to revision, with death treated as a competing risk. The estimated distribution function of the time to revision based on the Kaplan-Meier estimator is plotted alongside for comparison. The one minus Kaplan-Meier estimate is at most 10.4% larger than the competing risk cumulative incidence. Based on the competing risk analysis, the estimated probability of having revision (prior to death) by 20 years is 23.1% (95% CI 14.9 to 35.6).

Discussion

The most important finding in this study was the satisfactory survival of cementless components without screw holes, with the probability of no component revision at a mean follow-up of 22.9 years being 96.4%. While uncemented components are frequently employed, there are few published series on their longevity at 20 years.[10–17] In these reports,[10–17] components with supplementary screw, spikes, or pegs were used, and the immediate weightbearing status was either not mentioned or reported employing partial weightbearing for weeks.[1,10–17] Hence, this is the first cohort of more than 20 years' follow-up studying the survival of a cementless component without screw holes with immediate full weightbearing postoperatively. This combination is unique in demonstrating that press-fit alone can withstand the force from full weightbearing without macroscopic change, and is stable enough against the micromotion from full weightbearing to allow osseointegration.[18] This study testified press-fit stability as nothing else prevented the component from rotating within the acetabulum. This was further exaggerated by immediate full weightbearing with full joint contact forces acting on

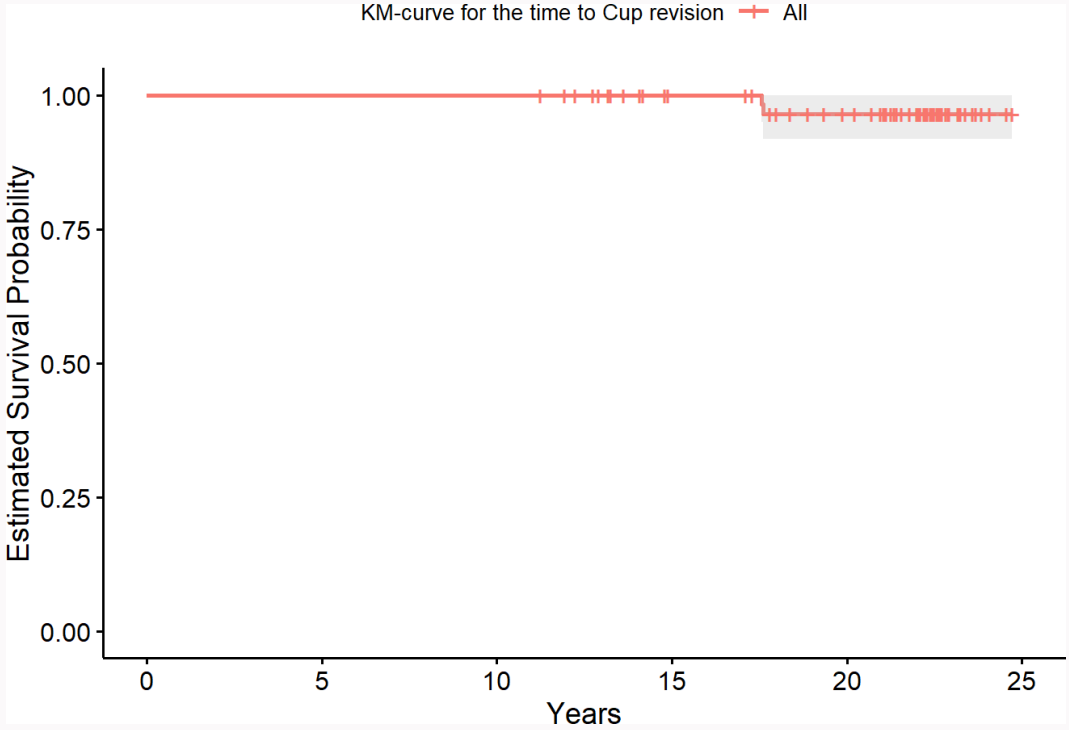

Fig. 3
The Kaplan-Meier (KM) curve for the time to component revision showed that the estimated survival probability was 96.4% at 20 years (95% CI 91.8 to 100).

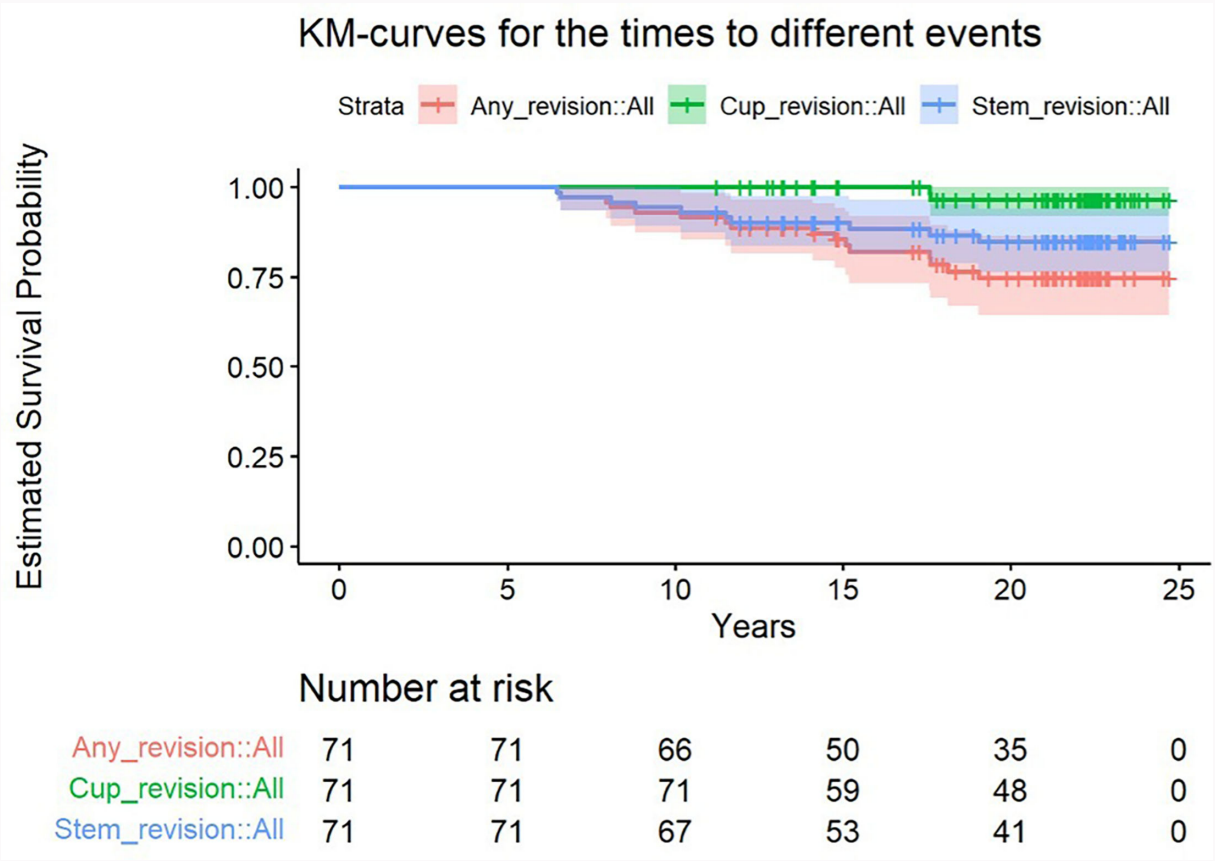

Fig. 4
The Kaplan-Meier (KM) curves for time to any hip revisions, component revisions, and stem revisions demonstrated that the majority of revisions resulted from stem revision.

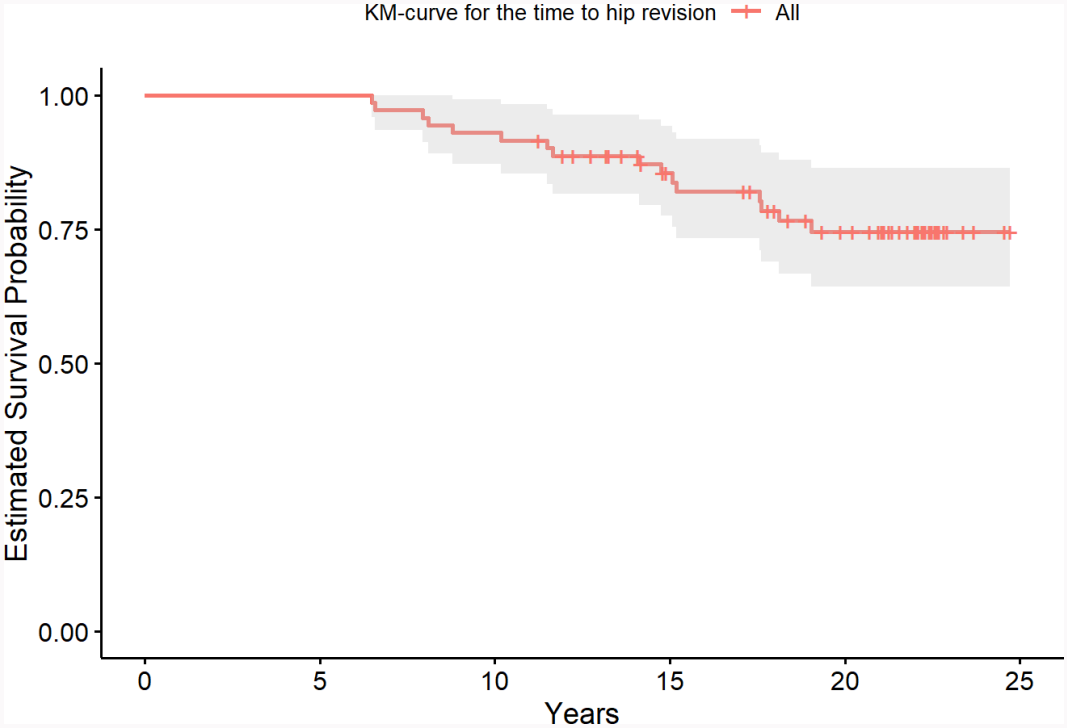

Fig. 5
The Kaplan-Meier (KM) curve for time to any hip revision showed that the estimated survival probability was 74.5% (95% CI 64.3 to 86.3) at 20 years.

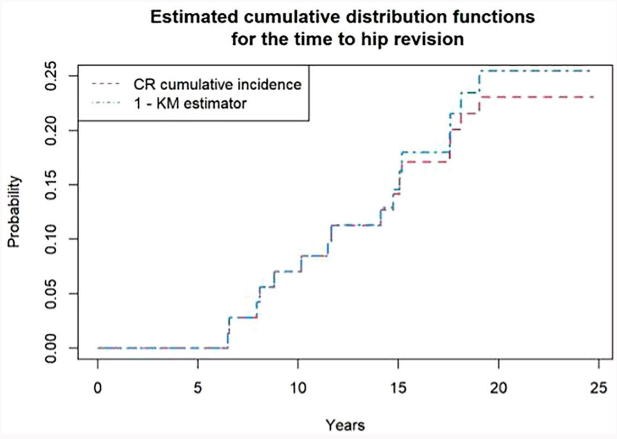

Fig. 6
The estimated cumulative incidence function for the time to hip revision based on the competing risk (CR) analysis and one minus the Kaplan-Meier (KM) curve for time to hip revision (with death treated as censoring).

short, mechanically disadvantaged lever arms in small Asian acetabula.[19,20]

One of the benefits of the component without screw holes lies in eliminating channels for PE particles passing to the component-bone interface, which contributes to central osteolysis.[3] The contemporary use of highly cross-linked polyethylene (HXLPE) has greatly reduced wear and minimized osteolysis.[21,22] Currently, most long-term studies of HXLPE report follow-up of five to 20 years.[21–23] All but one study has demonstrated lower wear and osteolysis rates with HXLPE.[22,24] Our previous study on HXLPE showed that the linear penetration rate was 0.0331 mm per year and annual volumetric wear was 5.569 mm^3 per year, in line with other studies.[21,22,25] While most of the recent studies showed no revision for osteolysis, this does not mean that HXLPE is wear-free, and with longer observation, which is currently lacking, PE particles could still be generated; whether they would cause osteolysis remains unknown.[22,25,26] With increasing life expectancy, soliciting every strategy to improve the longevity of THA is warranted.[27,28] This study provides long-term evidence that a component without screw holes inserted by press-fit technique is one of the strategies for long-term success, and this component configuration, together with HXLPE and a better stem choice, can provide long-term success for future patients.[28]

The no screw hole design of Duraloc 100 in minimizing osteolysis was evident when our study was compared with another long-term study using the Duraloc 500 (DePuy Synthes) with cementless stems.[2] The Duraloc 100 and Duraloc 500 components had similar designs, except that Duraloc 500 had two pegs and screw holes. Overall, 28% of the Duraloc 500 series developed osteolysis, with nine of the components revised for PE wear and acetabular osteolysis.[2] In contrast, none of the Duraloc 100 components had acetabular loosening, while 16 cases were revised for PE wear. Radiographs in the Duraloc 500 series showed central osteolysis behind the screw holes, but this was not found in our Duraloc 100 series.[2] However, two cases of peripheral osteolysis did occur with our Duraloc 100 series secondary to component malpositioning, leading to an inadequate seal at the periphery (Figures 2 and 3). In our series, loosening occurred in ten stems (nine were cemented stems (Table I)) compared to no stem loosening in the Duraloc 500 series using solely cementless stems. Of note, seven out of nine failed cemented stems were the Charnley Elite-Plus stems (DePuy Synthes), whose

survival rate was 59% at nine-year follow-up, with its rotationally unstable design attributed to its failure.[29] The remaining two cemented stem failures occurred with the Option 3000 component, which has the unique feature of cement only over the proximal body. This unconventional design had no mid- or long-term reports in the literature regarding its survival.[30]

The satisfactory survival of the Duraloc 100 was closely linked to our strategy of isolated liner exchange for PE wear.[31,32] The Duraloc 100 has avoided the development of central osteolysis and loosening, making isolated liner exchange possible. In turn, liner exchange has avoided the occurrence of catastrophic wear, such as PE being worn through necessitating component revision. This long-term study has the limitation of some patients dying at the end of the study. This led to the result of younger age (≤ 60 years) and initial diagnosis of AVN (presented at younger age) having more revision, as older patients died before requiring revision. Another limitation was that the limited sample size could not assess the relationship of cemented stem to overall revision, despite their apparent association. Similarly, given the exceedingly low rate of acetabulum component revision, its associated factors could not be derived. Furthermore, the operations were performed by a group of arthroplasty specialists (KYC, FYN, see Acknowledgements) practising in an academic unit, and therefore the result may not be fully generalized to every practice.

We performed both a standard survival analysis with death treated as censoring (using the Kaplan-Meier estimator) and a competing risk analysis with death treated as a competing risk. Importantly, the estimated distribution function of the time to revision based on Kaplan-Meier estimator is higher than or equal to the competing risk cumulative incidence function. The results based on the Kaplan-Meier estimator can be treated as conservative estimates, as they assume that revision risk is hypothetically still present after death. This assumption would produce more reasonable estimates if the death events were premature, as with recent pandemics. Additionally, the revision risk is already low using Kaplan-Meier estimator, and so we adopted it in our overall analysis.

In conclusion, this study demonstrated a long-term satisfactory outcome of 96.4% survival of a cementless component without screw holes with weightbearing immediately after operation, at a minimum of 20 years' follow-up.

Social media

Follow L. C. M. Lau on X @LCMLau and on Instagram @chunman.lau
Follow the authors on Instagram @hkuortho

Supplementary material

STROBE checklist.

References

1. **Kim YH**, **Park JW**, **Jang YS**, **Kim EJ**. Minimum 30-year results of bilaterally implanted cemented and cementless total hip arthroplasty in patients younger than 50 years. *J Arthroplasty*. 2023;38(5):873–879.
2. **García-Rey E**, **Carbonell-Escobar R**, **Cordero-Ampuero J**, **García-Cimbrelo E**. Outcome of a hemispherical porous-coated acetabular component with a proximally hydroxyapatite-coated anatomical femoral component: an update at 23 to 26 years' follow-up. *Bone Joint J*. 2019;101-B(4):378–385.
3. **Ng FY**, **Zhu Y**, **Chiu KY**. Cementless acetabular component inserted without screws - the effect of immediate weight-bearing. *Int Orthop*. 2007;31(3):293–296.
4. **Schmalzried TP**, **Jasty M**, **Harris WH**. Periprosthetic bone loss in total hip arthroplasty. Polyethylene wear debris and the concept of the effective joint space. *J Bone Joint Surg Am*. 1992;74-A(6):849–863.
5. **No authors listed**. 1st Annual Report. Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR). 2000. https://aoanjrr.sahmri.com/documents/10180/75186/Annual+Report+2000.pdf/af59fb64-dc05-4797-9fea-a23776187b5e?t=1349441309406&download=false (date last accessed 28 February 2025).
6. **Miura T**, **Kijima H**, **Kimura R**, **Watanabe J**, **Okazaki Y**, **Miyakoshi N**. Efficacy and safety of acetabular cup without screw fixation in total hip arthroplasty: a systematic review and meta-analysis. *Medicina (Kaunas)*. 2022;58(8):1058.
7. **Charlson ME**, **Pompei P**, **Ales KL**, **MacKenzie CR**. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373–383.
8. **Massin P**, **Schmidt L**, **Engh CA**. Evaluation of cementless acetabular component migration. An experimental study. *J Arthroplasty*. 1989;4(3):245–251.
9. **Martell JM**, **Pierson RH 3rd**, **Jacobs JJ**, **Rosenberg AG**, **Maley M**, **Galante JO**. Primary total hip reconstruction with a titanium fiber-coated prosthesis inserted without cement. *J Bone Joint Surg Am*. 1993;75-A(4):554–571.
10. **Gwynne-Jones DP**, **Lash HWR**, **James AW**, **Iosua EE**, **Matheson JA**. The morscher press-fit acetabular component: an independent long-term review at 18-22 years. *J Arthroplasty*. 2017;32(8):2444–2449.
11. **Kim YH**. Long-term results of the cementless porous-coated anatomic total hip prosthesis. *J Bone Joint Surg Br*. 2005;87-B(5):623–627.
12. **Belmont PJ**, **Powers CC**, **Beykirch SE**, **Hopper RH Jr**, **Engh CA Jr**, **Engh CA**. Results of the anatomic medullary locking total hip arthroplasty at a minimum of twenty years. A concise follow-up of previous reports. *J Bone Joint Surg Am*. 2008;90-A(7):1524–1530.
13. **Ihle M**, **Mai S**, **Pfluger D**, **Siebert W**. The results of the titanium-coated RM acetabular component at 20 years: a long-term follow-up of an uncemented primary total hip replacement. *J Bone Joint Surg Br*. 2008;90-B(10):1284–1290.
14. **Della Valle CJ**, **Mesko NW**, **Quigley L**, **Rosenberg AG**, **Jacobs JJ**, **Galante JO**. Primary total hip arthroplasty with a porous-coated acetabular component. A concise follow-up, at a minimum of twenty years, of previous reports. *J Bone Joint Surg Am*. 2009;91-A(5):1130–1135.
15. **Howard JL**, **Kremers HM**, **Loechler YA**, **et al**. Comparative survival of uncemented acetabular components following primary total hip arthroplasty. *J Bone Joint Surg Am*. 2011;93-A(17):1597–1604.
16. **Loughead JM**, **O'Connor PA**, **Charron K**, **Rorabeck CH**, **Bourne RB**. Twenty-three-year outcome of the porous coated anatomic total hip replacement: a concise follow-up of a previous report. *J Bone Joint Surg Am*. 2012;94-A(2):151–155.
17. **Kim YH**, **Park JW**, **Kim JS**, **Kim IW**. Twenty-five- to twenty-seven-year results of a cemented vs a cementless stem in the same patients younger than 50 years of age. *J Arthroplasty*. 2016;31(3):662–667.
18. **Manley MT**, **Ong KL**, **Kurtz SM**. The potential for bone loss in acetabular structures following THA. *Clin Orthop Relat Res*. 2006;453:246–253.
19. **Bergmann G**, **Bender A**, **Dymke J**, **Duda G**, **Damm P**. Standardized loads acting in hip implants. *PLoS One*. 2016;11(5):e0155612.
20. **Nam H-J**, **Lim Y-W**, **Jo W-L**, **et al**. Is the construct stability of the acetabular cup affected by the acetabular screw configuration in bone defect models? *J Orthop Surg Res*. 2023;18(1):354.

21. **Wright BH**, **Hadley ML**, **Harmer JR**, **Fruth KM**, **Sierra RJ**, **Couch CG**. No revisions attributable to wear of highly cross-linked polyethylene liners: a long-term follow-up study. *J Arthroplasty*. 2024;39(9S2):S347–S352.
22. **Langlois J**, **Hamadouche M**. What have we learned from 20 years of using highly crosslinked PE in total hip arthroplasty? *Orthop Traumatol Surg Res*. 2023;109(1S):103457.
23. **Parilla FW**, **Youngman TR**, **Layon DR**, **et al**. Excellent 20-year results of total hip arthroplasty with highly cross-linked polyethylene on cobalt-chromium femoral heads in patients ≤50 years. *J Arthroplasty*. 2024;39(2): 409–415.
24. **Tsukamoto M**, **Ohnishi H**, **Mori T**, **Kawasaki M**, **Uchida S**, **Sakai A**. Fifteen-year comparison of wear and osteolysis analysis for cross-linked or conventional polyethylene in cementless total hip arthroplasty for hip dysplasia-a retrospective cohort study. *J Arthroplasty*. 2017;32(1):161–165.
25. **Cheung A**, **Yan CH**, **Fu H**, **Cheung MH**, **Chan PK**, **Chiu KY**. Ten- to sixteen-year follow-up of highly cross-linked polyethylene in total hip arthroplasty: what factors affect wear? *J Arthroplasty*. 2019;34(9):2016–2021.
26. **Affatato S**, **Zanini F**, **Carmignato S**. Micro x-ray computed tomography mass loss assessment of different UHMWPE: a hip joint simulator study on standard vs. cross-linked polyethylene. *PLoS One*. 2017;-12(1):e0170263.
27. **Li Y**, **Wang K**, **Jigeer G**, **et al**. Healthy lifestyle and the likelihood of becoming a centenarian. *JAMA Netw Open*. 2024;7(6):e2417931.
28. **Hernigou P**, **Bumbasirevic M**, **Pecina M**, **Scarlat MM**. Eight billion people, sixteen billion hip joints today: are future orthopedists prepared to treat a world of ultra-old patients and centenarians in 2050? *Int Orthop*. 2024;48(8):1939–1944.
29. **Hauptfleisch J**, **Glyn-Jones S**, **Beard DJ**, **Gill HS**, **Murray DW**. The premature failure of the Charnley Elite-Plus stem: a confirmation of RSA predictions. *J Bone Joint Surg Br*. 2006;88-B(2):179–183.
30. **Einsiedel T**, **Gebhard F**, **Bregolato I**, **Hiemeier A**, **Kinzl L**, **Schultheiss M**. Proximal cement fixation in total hip arthroplasty--first results with a new stem design. *Int Orthop*. 2008;32(3):295–306.
31. **Liu WKT**, **Cheung A**, **Fu H**, **Chan PK**, **Chiu KY**. Acetabular component liner exchange with highly crosslinked polyethylene for wear and osteolysis. *Bone Joint J*. 2024;106-B(5 Supple B):59–65.
32. **Liu WKT**, **Cheung A**, **Fu H**, **Cheung MH**, **Chan PK**, **Chiu KY**. Isolated liner exchange in total hip arthroplasty at a mean of 13 years of follow-up: does fixation technique matter? *J Arthroplasty*. 2023;38(5):893–898.

Author information

L. C. M. Lau, MBChB, MRCSEd, FRCSEd (Orth), FHKCOS, FHKAM (Orthopaedic Surgery), PhD (Orthopaedics and Traumatology), Clinical Assistant Professor
M. H. Cheung, MBBS, MRCSEd, FRCSEd (Orth), FHKCOS, FHKAM (Orthopaedic Surgery), Honorary Clinical Assistant Professor
F. Y. Ng, MBBS, MRCSEd, FRCSEd (Orth), FHKCOS, FHKAM (Orthopaedic Surgery), Honorary Clinical Associate Professor
H. Fu, MBBS, MMedSc, MRCSEd, FRCSEd (Orth), FHKCOS, FHKAM (Orthopaedic Surgery), Clinical Assistant Professor
P. K. Chan, MBBS, MRCSEd, FRCSEd (Orth), FHKCOS, FHKAM (Orthopaedic Surgery), Clinical Associate Professor
K. Y. Chiu, MBBS, MRCSEd, FRCSEd (Orth), FHKCOS, FHKAM (Orthopaedic Surgery), Honorary Clinical Professor
Department of Orthopaedics and Traumatology, School of Clinical Medicine, The University of Hong Kong, Hong Kong, China.

K. Y. Wong, BSc (Actuarial Science), MPhil, PhD (Biostatistics), Associate Professor
H. Hu, BSc, Researcher
Department of Applied Mathematics, The Hong Kong Polytechnic University, Hong Kong, China.

Author contributions

L. C. M. Lau: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing, Supervision.
K. Y. Wong: Formal analysis, Investigation, Methodology, Validation, Writing – review & editing.
H. Hu: Data curation, Formal analysis, Validation, Visualization.
M. H. Cheung: Data curation, Writing – review & editing.
F. Y. Ng: Conceptualization, Data curation, Investigation.
H. Fu: Project administration, Supervision, Validation.
P. K. Chan: Data curation, Project administration, Supervision, Writing – review & editing.
K. Y. Chiu: Conceptualization, Data curation, Methodology, Project administration, Resources, Supervision, Writing – review & editing.

Funding statement

The author(s) received no financial or material support for the research, authorship, and/or publication of this article.

ICMJE COI statement

K. Y. Chiu is a paid consultant for Depuy Synthes, Johnson & Johnson, Smith & Nephew, Stryker, Mako, Zimmer Biomet, and Microport, unrelated to this study.

Data sharing

The data that support the findings for this study are available to other researchers from the corresponding author upon reasonable request.

Acknowledgements

The authors would like to acknowledge W. M. Tang, W. P. Yau, and T. P. Ng for contributing the cases in this series.

Ethical review statement

This study is approved by the institutional review board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster (HKU/HA HKW IRB), with ID: UW 23-520.

This paper was presented at the International Hip Society 2024 Meeting in Athens, Greece.