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Case Report

A Combined Use of Custom-Made Partial Pelvic Replacement and Proximal Femur Megaprosthesis in the Treatment of Severe Bone Loss after Multiple Total Hip Arthroplasty Revisions

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Abstract: Hip arthroplasty failures (either septic or aseptic) often require multiple revisions, thus leading to severe bone defects. The most common reconstruction methods do not allow the management of severe defects. For this reason, in recent years, techniques borrowed from surgical oncology have been applied in the field of revision surgery to deal with both acetabular and femoral bone losses. In this article, two cases of severe bone deficiency following multiple hip arthroplasty revisions that were treated with a custom-made hip prosthesis combined with a proximal femur megaprosthesis are presented. Both implants were silver coated. A review of the literature was conducted to analyze similar cases treated with either a custom-made prosthesis or a proximal femur megaprosthesis. At the 2-year follow-up, all prostheses were in site without clinical or radiographic signs of implant loosening. No postoperative complications occurred. At the last follow-up, both patients resumed their daily life activities with an MSTS score of 23 and 21, respectively. The combined approach of a proximal femur megaprosthesis with a custom-made partial pelvic replacement is a solution that allows severe bone deficiency cases to be tackled with good functional results. Additionally, silver coating may help prevent recurrence of infection.

Keywords: severe bone loss; revision hip arthroplasty; custom-made; megaprosthesis; silver

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1. Introduction

The number of primary total hip arthroplasty (THA) is progressively increasing every year [1], thus potentially enlarging the burden of complications and the number of revisions and re-revision of THA. Moreover, many THAs are performed on younger and more active patients. This subgroup of patients is keener on multiple revisions during their life [2]. The individual life-long risk of further revision for a patient undergoing THA revision is 16.1% at 3 years and 19.4% at 5 years after surgery [3].

The most common reasons for revision surgery are aseptic loosening, hip Instability, peri-prosthetic fractures, pseudotumor and peri-prosthetic joint infection (PJI). In the case of aseptic loosening, a one-stage revision is indicated, with prosthesis removal and re-implantation within the same surgery. On the other hand, PJI generally requires a staged approach, with or without the implant of a temporary spacer [4–6].

Two-stage revision is also recommended in selected cases of pseudotumor [7], which is performed sometimes after preoperative selective arterial embolization [8].

In the case of severe PJI or large pseudotumors, resection arthroplasty (Girdlestone procedure) or hip disarticulation can be considered as salvage procedures [9–14].

Revision THA is technically demanding, and severe bone loss, either on the femoral or acetabular side, is an important issue to be addressed [15].

The Paprosky and the AAOS classifications can be used to assess the extent of bone loss, thus helping to choose the most suitable reconstruction [16–19]. In addition, further classifications have recently been proposed to overcome the limitations of these previous classifications [20,21].

The acetabulum might be reconstructed with non-cemented cups for small defects [22,23] and jumbo cups, cages or reinforcement rings, trabecular metal cups and augments, allograft prosthetic composites and ice cone cups for segmental defects. Ice cone cups and allograft prosthetic composites can be used in pelvic discontinuities [24–26].

On the femoral side, reconstructive options include cementless and cemented standard stems, proximally fixed stems, calcar replacement stems, extensively distally or proximally porous-coated stems, modular stems that are fluted distally and porous coated proximally, impaction grafting plus cemented stem, and allograft prosthetic composites [27].

However, in the case of very large defects, custom-made (CM) 3D-printed prosthesis and proximal femur (PF) megaprosthesis (MP) have been proposed [16–28].

Custom-made prostheses are fully personalized implants. In the case of THA revision, a "filling" CM prosthesis is generally suggested to achieve a more complete anatomical reconstruction, preserving as much bone as possible. However, when the bone defect shape is uneven and an accurate prosthesis-to-bone contact is difficult to achieve, a resection CM implant is preferred [29]. Similarly, in the case of massive femoral bone loss, a megaprosthesis may be the only suitable implant.

Moreover, in the case of a PJI or in the case of a high risk of infection, prosthetic components can be modified by adding an antibacterial coating such as silver [30–33].

This paper aims to report on two cases of severe pelvic and femoral bone deficiency after multiple THA revisions, which were treated with a combination of CM pelvic prosthesis and silver-coated PF MP.

To the best of our knowledge, this is the first report on the combined use of these silver-coated implants in hip revision surgery.

Moreover, we provide a review of the published literature where similar cases were treated with either a PF MP or a CM prosthesis.

2. Case Presentation

2.1. Case #1

A 49-year-old man came to our attention with a painful THA. He previously had hip and pelvic fracture following a road accident 28 years ago and was treated with osteosynthesis. One year after, he developed a fracture-related infection and, thus, was treated with hardware removal and debridement. He underwent THA two years later. Unfortunately, he developed a PJI which was treated using a staged approach and reconstructed with a stemmed acetabular cup and a standard uncemented femoral stem.

Radiography, computerized tomography (CT) and magnetic resonance imaging (MRI) of the pelvis and hip showed prosthesis loosening with severe bone losses on both the acetabular and femoral sides, with a large pseudotumor (Figures 1 and 2A).

The patient underwent a staged revision. Surgeries were performed via the extended ileo-femoral approach.

At the first-stage surgery, the pseudotumor was excised en bloc and 3 cm of residual proximal femur was resected. The acetabulum was exposed, showing cup loosening and broken polyethylene liner. Intraoperatively, five tissue specimens were taken from representative areas. All the prosthesis components were removed and sent for sonication. A pre-formed cement spacer (spacer G, Tecres SpA, Verona, Italy) was positioned to replace the proximal femur, and a molded cement spacer was created to fill the acetabulum bone defect (Figure 2B). Empirical intravenous antibiotic therapy was started. Intraoperative cultures and histology ruled out an infection; therefore, antibiotics were stopped.

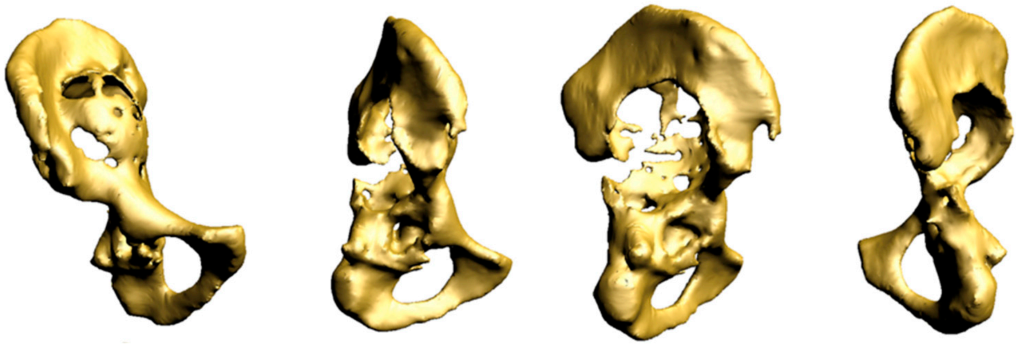

Figure 1. CT-based 3D reconstruction of the bone defect.

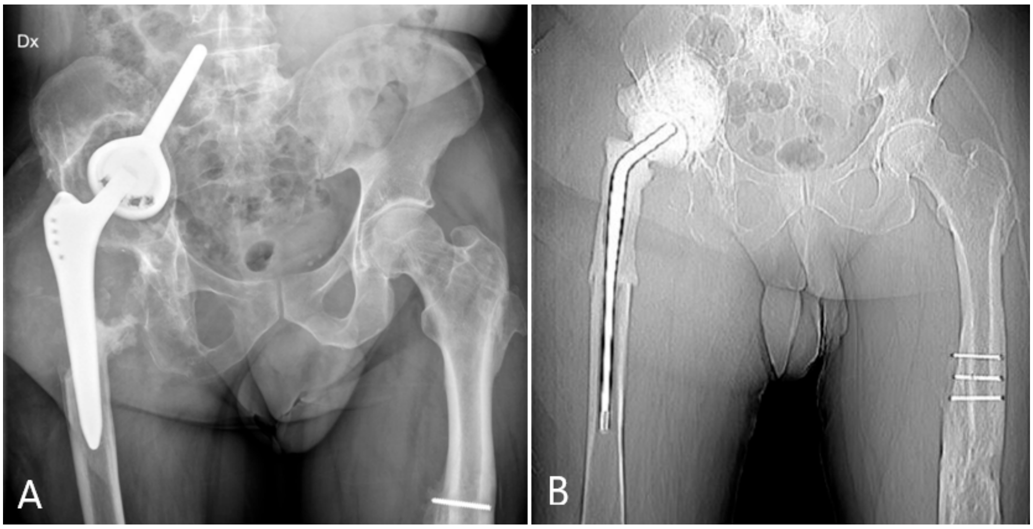

Figure 2. (**A**) Anteroposterior radiographs of the pelvis showing right total hip arthroplasty loosening with large osteolysis. (**B**) Anteroposterior radiographs of the pelvis after prosthesis removal and implantation of a spacer.

From computerized tomography (CT) of the pelvis, 2 mm thick slices were acquired, and the 3D models of the bones were generated through segmentation of the CT images. The patient had a massive bone defect with a cranial hole resulting from the previous iliac stem, which damaged part of the sacroiliac joint, and a completely destroyed posterior column.

A prosthesis was then designed (Lima Corporate, San Daniele del Friuli, Udine Italy), aiming to obtain good contact between the host bone and the prosthesis and to allow optimal integration. This was a titanium acetabular custom-made cup with a cranial augment for bone defect and an iliac flange fixed by an iliac stem and iliac, ischial, pubic and sacrum screws (for a total of eight screws) (Figure 3A). The prosthetic surface had pores with an average size of 0.7 mm, allowing the host bone to grow directly inside the implant spaces, thus increasing biological fixation. The position of the center of rotation was not completely restored due to the poor quality of the bone in the periacetabular area, which was severely deformed, and also due to the previous use of bone grafts. Therefore, the center of rotation was lateralized to avoid the risk of structural damage at that level, which would have hindered good implant placement. Patient-specific instruments (PSIs) were also designed to have a specific contact surface to fit into the unique position on the host bone (Figure 3B). The proximal femur was reconstructed with a PF silver-coated cemented MP (Waldemar Link Gmb & Co. KG, Hamburg, Germany). Dual-mobility coupling was applied to improve the stability of the implant.

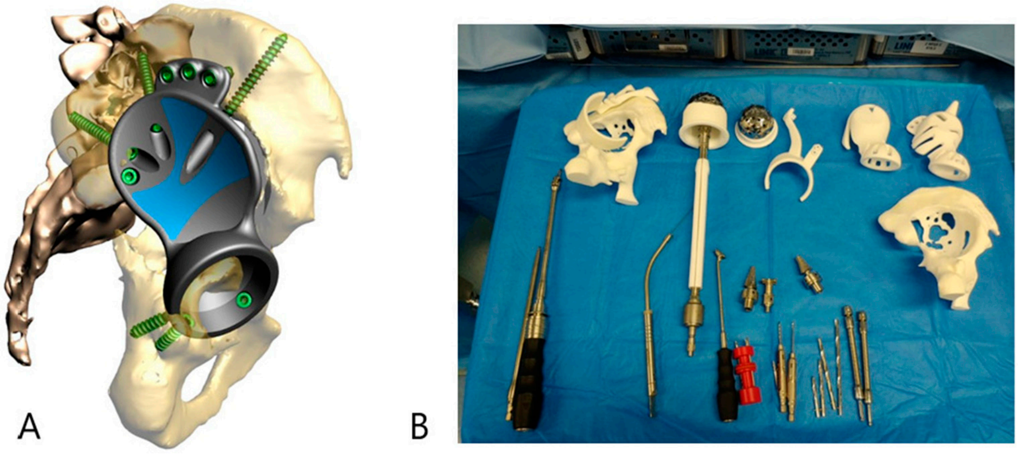

Figure 3. (**A**) A filling custom-made prosthesis was designed. (**B**) Patient-specific instruments.

The surgery for reimplantation was performed 65 days after the first stage. The operative time was 225 min. The peri-operative estimated blood loss was 1250 mL.

Postoperatively, a hip brace was placed for 30 days. Thereafter, the patient was allowed a progressively increased range of motion. No weight bearing was allowed for 30 days. Full weight bearing and free walking were allowed 5 months after surgery.

At the final follow-up (27 months), radiographs showed correct positioning of the implant, with no signs of loosening (Figure 4). The patient walked with no aids and no pain; quadriceps strength was good, and active flexion allowed over 100° without pain. The Musculoskeletal Tumor Society (MSTS) score was 23.

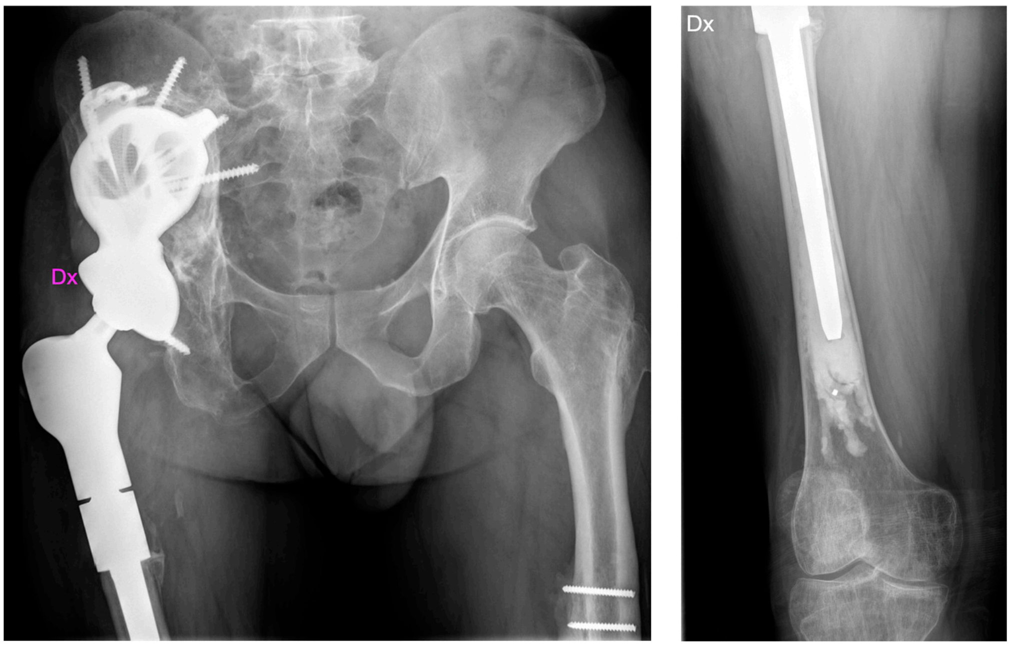

Figure 4. Anteroposterior radiographs of the pelvis showing reconstruction on the right side with a custom-made prosthesis and a proximal femur megaprosthesis at final follow-up.

2.2. Case #2

A 37-year-old female came to our attention with a Girdlestone hip joint after the THA had been removed elsewhere 10 months before because of a PJI (methicillin-resistant coagulase-negative Staphylococcus was isolated). That surgery was complicated by an intraoperative femoral fracture. The THA had been implanted 20 years before due to post-traumatic sequelae. A previous revision of the acetabular cup was performed because of aseptic loosening 6 years before.

At presentation, radiographs and CT of the pelvis showed severe acetabular bone deficiency and pseudoarthrosis of the proximal femur (Figure 5). There were no clinical signs of infection. C-reactive protein and leucocyte-labeled scintigraphy ruled out a PJI.

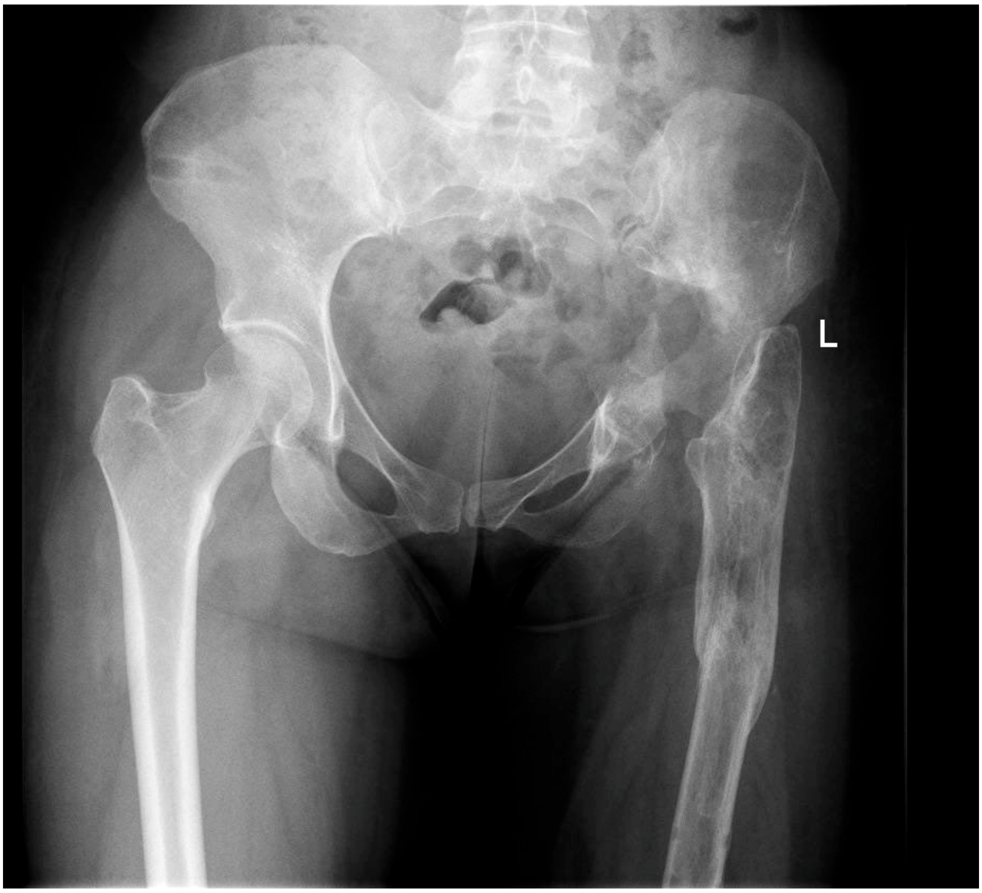

Figure 5. Anteroposterior radiographs of the pelvis showing large osteolysis on the left periacetabular area and proximal femur post-traumatic deformity.

Three-dimensional models of the bones were generated through segmentation of the CT images.

The patient had a massive bone defect on the acetabular side. Moreover, there was an extended pseudoarthrosis of the proximal femur with a left lower limb hypometria of 45 mm (Figure 6).

A prosthesis was then designed (Waldemar Link GmbH & Co. KG, Hamburg, Germany), aiming to obtain good contact between the host bone and the prosthesis and to allow optimal integration. This was a titanium acetabular cup with three augmentation flanges (one ischiatic, one iliac and one pubic fixed by a total of seven screws), an iliac stem for prosthesis main anchoring, and total Por-Ag® silver-coating (Figure 7). Patient-specific instruments (PSIs) were also designed to have a specific contact surface to fit into the unique position on the host bone. The CM pelvic prosthesis was projected to be compatible with a cemented Megasystem-C PF MP (Waldemar Link GmbH & Co. KG, Hamburg, Germany) which was silver coated.

Also, in this case, dual-mobility coupling was used. The surgery was performed via the extended ileo-femoral approach. The operative time was 202 min. The peri-operative estimated blood loss was 950 mL.

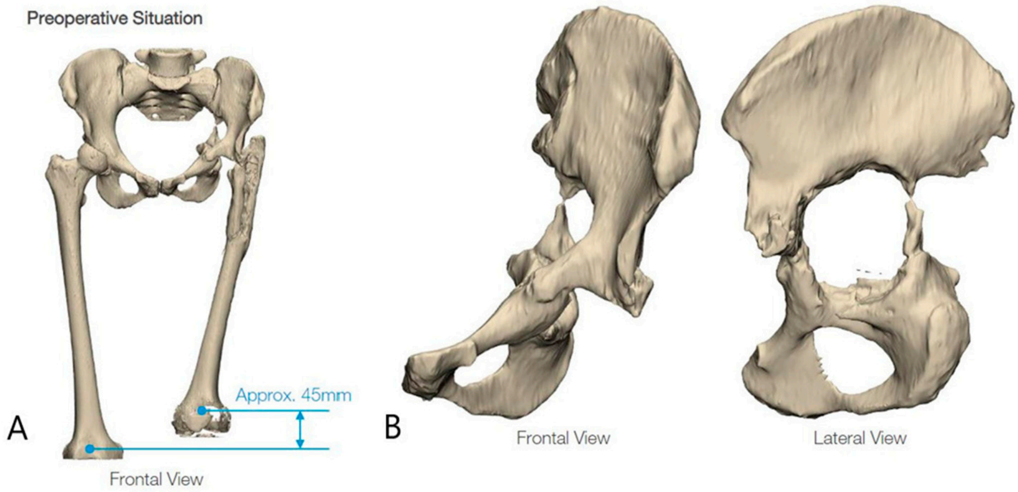

Figure 6. Three-dimensional reconstruction of the pelvis and proximal femur based on computerized tomography scans. (**A**) highlights a length discrepancy of approximately 45 mm. (**B**) Type 3C Paprosky acetabular bone defect.

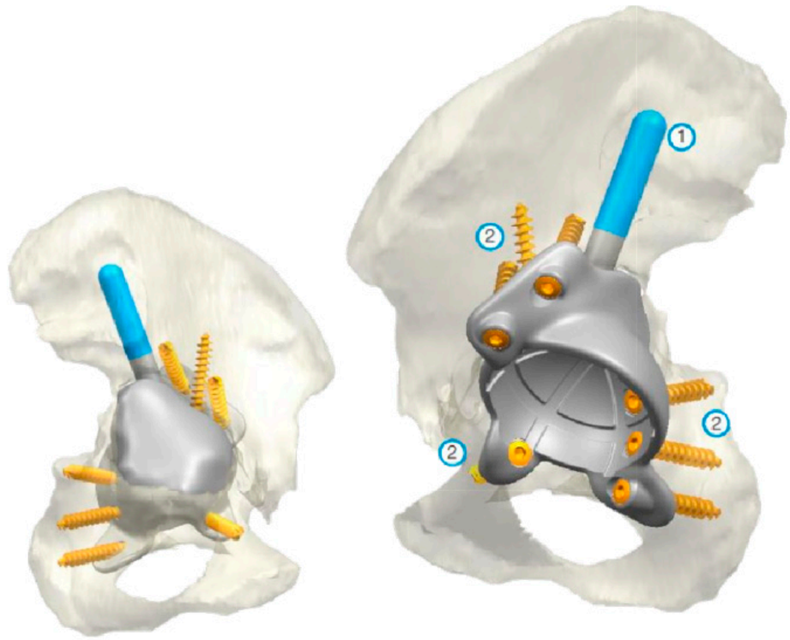

Figure 7. A filling custom-made prosthesis.

Postoperatively, a hip brace was placed for 70 days and then gradually removed, allowing for progressive hip flexion. No weight bearing was allowed for 50 days; thereafter, incremental weight bearing was allowed. Full weight bearing and free walking were allowed 5 months after surgery.

At the final follow-up (19 months), radiographs showed no signs of implant loosening. (Figure 8). The MSTS score was 21. The patient was pain-free during walking, quadriceps strength was good, and active flexion allowed over 95° without pain. A residual 10 mm hypometria of the left limb was recorded on the lower limb plain radiographs.

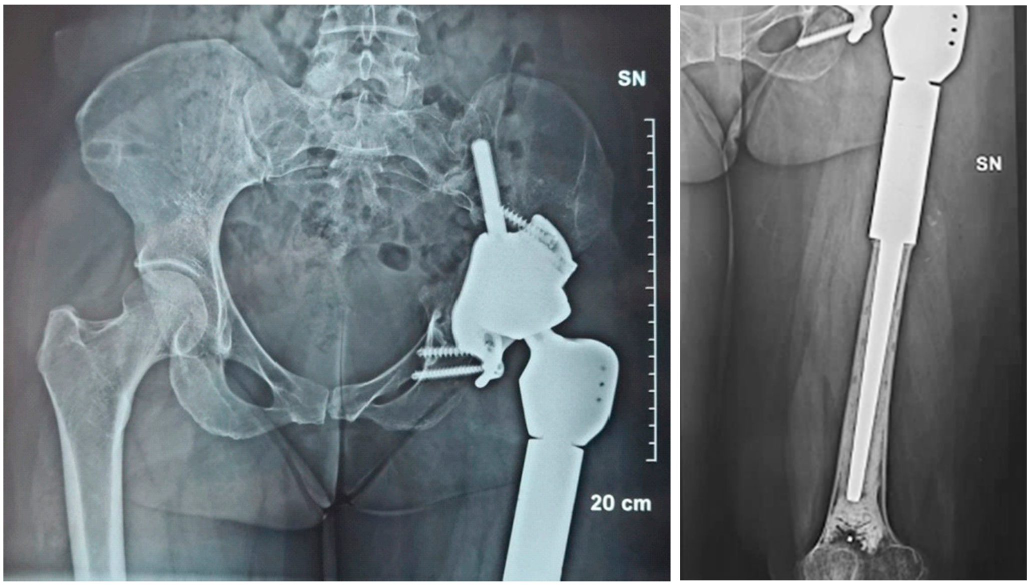

Figure 8. Anteroposterior radiographs of the pelvis showing reconstruction on the left side with a custom-made prosthesis and a proximal femur megaprosthesis at final follow-up.

3. Discussion

We reported two cases of THA re-revision where severe bone loss could be successfully managed with the combined implantation of a proximal femur megaprosthesis and a 3D-printed custom-made pelvic prosthesis. Despite many studies reporting on the use of either CM implants or PF MP to treat severe bone deficiency, with one study reporting four cases on the combined use of these implants in hip revision surgery [34], to the best of our knowledge, this is the first report in which this combination was associated with silver coating (on MP for the first case and both CM pelvic prosthesis and PF MP for the second case) [35,36].

Major acetabular bone deficiencies make reconstructive procedures technically demanding. Many techniques have been proposed in the literature for the management of these large bone defects [37]. Uncemented, hemispherical acetabular component secured with multiple screws and used in conjunction with bone allograft to fill the defect is the most commonly used technique, with reported excellent long-term results [16]. In cases of severe bone loss, structural bone grafts are often required to provide immediate support for implant stability [38]. However, there are situations in which the acetabulum is so deficient that even a highly porous hemispherical component combined with metal augments or a structural bone graft cannot provide sufficient mechanical stability when placed in the correct anatomical location [39].

Custom-made implants represent the most extreme solution, which should be considered when no other reconstructions are feasible [39,40]. (Table 1) Custom-made implants allow filling and bridging of any extensive bone defect [40]. Other advantages consist in the possibility of accurate preoperative planning and preoperative trial surgery. Existing series reporting on CM prosthesis in non-oncologic cases are extremely heterogenous, both in terms of indication to surgery and design of the prosthesis. Most of the protheses were designed as triflanged cups, with none being silver coated. Most of these series reported very high complication rates.

Table 1. Review of the literature: series reporting on the use of custom-made prosthesis to treat revision total hip arthroplasty.

Study	Number of Cases	Mean Age (Years)	Indications	Bone Defects	Implant Features	Silver Coating	Mean FU (Years)	Complication Rate (%)	Dislocation Rate (%)	PJI Rate (%)	Further Revision Rate (%)	Implant Survival (%) *	Last FU Functional Evaluation
Christie et al., 2001 [41]	67	59	Failed THA	AAOS III-IV	Ti triflanged	No	4.4	28	18	0	9	100	HHS 82
Joshi et al., 2002 [42]	27	68	Failed THA	AAOS III	Ti triflanged	No	4.8	22	4	7	14	100	NR
Holt et al., 2004 [43]	26	69	NR	P. III B	Ti triflanged	No	4.5	27	8	0	4	88	HHS 78
De Boer et al., 2007 [44]	20	56	Failed THA	AAOS IV	Ti triflanged	No	10.25	40	30	0	30	100	HHS 80
Taunton et al., 2012 [45]	57	61	Failed THA	AAOS IV	Ti triflanged	No	6.3	47	21	7	30	95	HHS 75
Colen et al., 2013 [46]	6	69	Failed THA	AAOS III-IV	Ti triflanged	No	2.4	0	0	0	0	100	HHS 61
Wind et al., 2013 [47]	19	58	Aseptic loosening PJI Dislocation	P. IIIA-IIIb	Ti triflanged	No	2.6	53	26	5	32	89	HHS 63
Friedrich et al., 2014 [48]	18	68	Aseptic loosening PJI	P. IIIB	Ti triflanged	No	2.5	33	17	11	28	89	HHS 69
Berasi et al., 2015 [49]	24	67	Aseptic loosening PJI Dislocation	P. IIIB	Ti triflanged	No	4.75	26	0	8	17	92	HHS 65
Barlow et al., 2015 [50]	63	63	Aseptic loosening PJI	P: IIIB	Ti triflanged	No	4.3	27	0	3	27	86	NR
Mao et al., 2015 [51]	23	61	Aseptic loosening PJI	P. IIIA-IIIB	Ti cage dome, hook flange or three-braid porous	No	6.9	22	9	0	4	91	HHS 81
Li et al., 2016 [52]	24	65	Aseptic loosening PJI	P. IIIB	cage with iliac wing/braid, ischial flange or crest obturator hook	No	5.6	17	4	4	8	100	HHS 82
Baauw et al., 2016 [53]	9	66	Aseptic loosening Girdlestone	P. IIIA/IIIB	Ti triflanged	No	NR	33	8	0	0	100	NR
Citak et al., 2018 [54]	9	67	PJI	P. IIIA-IIIB	Ti triflanged	No	2.4	67	33	0	67	89	HHS 59
Gladnick et al., 2018 [55]	73	60	Aseptic loosening PJI Dislocation Periprosthetic fracture	P. IIIB	Ti triflanged	No	7.5	37	10	11	36	90	NR

Table 1. *Cont.*

Study	Number of Cases	Mean Age (Years)	Indications	Bone Defects	Implant Features	Silver Coating	Mean FU (Years)	Complication Rate (%)	Dislocation Rate (%)	PJI Rate (%)	Further Revision Rate (%)	Implant Survival (%) *	Last FU Functional Evaluation
Berend et al., 2018 [56]	95	66	Aseptic loosening PJI Dislocation Periprosthetic fracture Cage failure	P. IIC-IIIA-IIIB	Ti triflanged	No	3.6	22	6	6	22	93	HHS 75
Kieser et al., 2018 [57]	36	68	Aseptic loosening PJI Dislocation Periprosthetic fracture Metallosis	P. IIA-IIIB	Ti triflanged	No	3.2	11	3	3	3	97	HHS 79
Moore et al., 2018 [58]	35	60	Aseptic loosening Periprosthetic fracture	NR	Ti triflanged	No	10	11	0	6	8	91	HHS 90
Gruber et al., 2020 [59]	16	69	Aseptic loosening Septic loosening Periprosthetic fracture	P. IIIA-IIIB	Ti triflanged	No	1	33	12	0	6	NR	HHS 53
Walter et al., 2020 [60]	58	69	Aseptic loosening PJI Dislocation Girdlestone	P. IIIA-IIIB	Ti triflanged	No	5	50	9	12	36	72	HHS 60
Von Hertzberg-Boelch et al., 2021 [61]	114	69	Aseptic loosening PJI	P. IIIA-IIIB	Monoflang ed	No	2.9	56	21	3	50	60	NR
Froschen et al., 2022 [62]	4	68	PJI	P. IIIA-IIIB	Monoflang ed	No	2	50	25	50	5	50	HHS 50
Augustyn et al., 2022 [63]	1	74	Metallosis	P. IIIB	Ti triflanged	No	1.2	NR	NR	NR	NR	NR	HHS 81
Winther et al., 2022 [64]	39	69	Aseptic loosening PJI	All pelvic discontinuity	Ti triflanged	No	5	21	8	8	21	NR	HHS 80

* Implant survival: patients with prosthesis in site at last follow-up. Abbreviations: NR: not reported; THA: total hip arthroplasty; AAOS: American Academy of Orthopedic Surgeons classification for acetabular bone loss; P: Paprosky classification for acetabular bone loss; PJI: periprosthetic joint infection; HHS: Harris Hip Score; Ti: titanium.

Patient-specific instruments have been demonstrated to be of added value to improve osteotomy accuracy, and they may improve pelvic surgery by providing clinically acceptable margins and ameliorating prosthesis bone contact [65–67]. Custom-made prosthesis can reduce surgical time, thus potentially reducing the risk of infections [6]. In addition, meticulous planning of screw insertion can be carried out, thus avoiding injuries to the neurovascular structures [68]. On the other hand, CM prothesis does not allow for any variation in surgical plan during surgery. Moreover, the production of a CM prosthesis usually takes 4-6 weeks [48]. This is relevant in terms of surgical planning, particularly in an oncological setting where a therapeutic delay can affect the prognosis. However, also in non-oncological settings, as in the cases described in this article, the time required for surgical planning can affect the outcome. In fact, morphological changes at the surgical site may occur progressively, thereby affecting the accuracy of matching between the planned prosthesis and effective anatomy at the time of surgery. This is mostly due to further bone loss, as well as the occurrence of ossifications. In settings that can benefit from a two-stage intervention, the placement of cement spacers can help reduce the risk of bone modifications. In addition, in the authors' opinion, a two-stage treatment may also help reduce the infectious risk, especially in the treatment of periprosthetic infection sequelae. This is both because surgical debridement can be performed twice and because the two surgeries would be expected to have a shorter duration and result in less blood loss than a single-stage surgery. Some authors stated that the overall cost of the procedure with CM devices is higher than other reconstruction techniques, even though little is still known about a complete cost-effectiveness analysis of CM implants [69].

On the femoral side, many studies reported the use of porous-coated standard metaphyseal fitting stems for Type III defects, with variable but generally high failure rates [70,71]. Impaction grafting of the defective femur and reconstruction using a cemented stem was successfully reported by Duncan et al. [72]. These excellent results were confirmed by Ornstein et al. (94% survival rate after 15 years). However, the technique of impaction grafting is challenging and time-consuming because of the specialized instrumentation needed and the large volume of cancellous bone allografts required [73]. Modular cementless tapered fluted stems can be a viable alternative. Although they are deemed to have high dislocation rates in the past, newer stem designs with modular components are associated with lower rates of subsidence, improved restoration of limb length and femoral offset [74–76].

Nevertheless, none of these options can be considered a viable and successful option for Type IV femur defects. Allograft prosthetic composites are a valid, biological, but technically demanding reconstructive option [77]. They allow the restoration of bone stock, thus establishing a good bony foundation for potential future revisions. However, data on this technique in revision THA surgery are very heterogeneous since different allograft fixation techniques have been reported. Generally, resorption of the allograft and non-unions are the main reported complications [78]. In addition, the use of an MP allows the center of rotation of the CM pelvic prosthesis to be optimized during the implant planning phase. Indeed, because of the modularity of the PF MP, it would have been possible to circumvent any intraoperative difficulties in restoring limb length due to tissue retraction and fibrosis. However, there may be limits to the possibility of fully correct preoperative dysmetria. For example, in the second case described, the patient had suffered a shortened limb for years, and we preferred to not fully correct the dysmetria to avoid excessive soft tissue tension and possible neurological consequences.

The use of a PF MP allows a reduced surgical time and an earlier weight bearing. (Table 2) However, a PF MP is deemed to lead to a probable severe deficit of glutei muscles as these must be reattached to the metal prosthesis. Moreover, a higher rate of infection and dislocation has been reported in comparison to conventional prosthesis. In particular, the PF MP infection rate is reported to be about 7% versus 1% infection rate in primary THA [79,80].

Table 2. Review of the literature: series reporting on the use of proximal femur megaprosthesis to treat revision total hip arthroplasty.

Study	Numbe r of Cases	Mean Age (Years)	Indications	Implant Features	Silver Coating	Mean FU (Years)	Complication Rate (%)	Dislocation Rate (%)	PJI Rate (%)	Further Revision Rate (%)	Implant Survival (%)	Last Follow-Up Functional Evaluation
Malkani et al., 1995 [81]	30	61	Aseptic loosening Periprosthetic fracture PJI	Cemented stem with custom-made proximal femur component	No	11.1	70	37	10	53	64% at 12 years	HHS 76
Haentjens et al., 1996 [82]	16	78	Aseptic loosening	Cemented stem with large stainless-steel proximal femoral component	No	5	62	44	12	50	NR	NR
Klein et al., 2005 [83]	21	78	Periprosthetic fracture	Cemented antibiotic-loaded stem with proximal porous coating	No	3.2	38	9	9	9	NR	HHS 71
Parvizi et al., 2007 [84]	43	74	Aseptic loosening Periprosthetic fracture PJI Non-union Osteonecrosis	Cemented modular replacement system with porous coated proximal stem	No	3	30	19	2	42	87% at 1 year 73% at 5 years	HHS 65
Shih et al., 2007 [85]	12	59	Aseptic loosening Periprosthetic fracture PJI	Cemented antibiotic-loaded modular EPR	No	5.7	116	42	33	42	NR	HHS 83
Shoenfeld et al., 2008 [86]	19	76	Proximal femur fracture Proximal femur non-union	Howmedica® Biomet® EPR	No	3.7	26	16	5	16	NR	MDA 14.3
Hardes et al., 2009 [87]	28	72	Aseptic loosening Periprosthetic fracture PJI	Multiple systems	No	3.8	28	14	7	29	812% at 5 years	HHS 66
Rodriguez et al., 2009 [88]	97	NR	Proximal femur bone loss	Link® MP modular	No	3.2	18	10	0	12	NR	HHS 84
Gebert et al., 2010 [89]	45	62	Aseptic loosening Periprosthetic fracture PJI	MUTARS Implantcast®	No	3.2	18	2	11	18	85% at 10 years	HHS 78
Sewell et al., 2010 [90]	15	67	Aseptic loosening Periprosthetic fracture PJI	METS Stanmore®	No	5	27	13	13	13	87% at 5 years	HHS 69

Table 2. *Cont.*

Study	Numbe r of Cases	Mean Age (Years)	Indications	Implant Features	Silver Coating	Mean FU (Years)	Complication Rate (%)	Dislocation Rate (%)	PJI Rate (%)	Further Revision Rate (%)	Implant Survival (%)	Last Follow-Up Functional Evaluation
Al-Taki et al., 2011 [91]	36	73	Aseptic loosening Periprosthetic fracture PJI Dislocation	Cemented or cementless MRS Stryker®	No	3.2	14	8	3	14	NR	OHS 70 WOMAC 71
McLean et al., 2012 [92]	20	72	Periprosthetic fracture	Cemented GMRS Stryker®	No	4	30	15	10	20	NR	TESS 68
Dean et al., 2012 [93]	8	67	Failed internal fixation for proximal femur fracture	METS Stanmore®	No	1.5	0	0	0	NR	NR	HHS 71
Calori et al., 2013 [94]	11	68	Aseptic loosening Periprosthetic fracture PJI Non-union	NR	Si	1.5	9	9	0	9	NR	NR
Grammatopoulos et al., 2016 [95]	79	69	Aseptic loosening Periprosthetic fracture PJI Non-union Pseudotumor	NR	No	5	25	4	11	NR	87% at 5 years	NR
Curtin et al., 2017 [96]	16	75	Aseptic loosening Periprosthetic fracture Proximal femur bone loss	Cemented or cementless LPS DePuy®	No	1.6	12	12	0	6	94% at 1.6 years	OHS 40
Viste et al., 2017 [97]	44	79	Aseptic loosening Periprosthetic fracture PJI Dislocation	Cemented EPR	No	6	27	14	2	4	86% at 5 years 66% at 10 years	HHS 68
Khajuria et al., 2018 [98]	37	80	Aseptic loosening Periprosthetic fracture PJI Non-union Pediatric arthrodesis	METS Stanmore®	No	2.7	8	3	5	5	97% at 1 year 95% at 5 years	OHS 31
De Martino et al., 2019 [99]	31	64	Aseptic loosening Periprosthetic fracture PJI Non-union	GMRS Stryker®	No	5	29	6	10	29	78% at 5 years	NR

Table 2. *Cont.*

Study	Numbe r of Cases	Mean Age (Years)	Indications	Implant Features	Silver Coating	Mean FU (Years)	Complication Rate (%)	Dislocation Rate (%)	PJI Rate (%)	Further Revision Rate (%)	Implant Survival (%)	Last Follow-Up Functional Evaluation
Fenelon et al., 2020 [100]	79	78	Aseptic loosening Periprosthetic fracture PJI Non-union severe osteoarthritis fracture	GMRS Stryker® LPS DePuy®	No	2.6	15	11	4	5	96% at 1 year 95% at 5 years	NR
Döring et al., 2021 [28]	28	67	Aseptic loosening Periprosthetic fracture PJI Non-union Dislocation Proximal femur fracture	KMFTR Howmedica® HMRS Howmedica® GMRS Stryker®	No	7.3	64	28	0	36	68% at 1 year 46% at 5 years 38% at 10 years	NR
Logoluso et al., 2022 [15]	21	68	PJI	Cemented or cementless Mega C-System Link® Distally interlocked modular femoral reconstruction prosthesis REEF®	Si	5.3	67	38	10	14	83% at 2 and 5 years	NR
Zanchini et al., 2023 [101]	39	69	Periprosthetic fractures Bone loss PJI	GMRS Stryker®	No	5	18	5	8	10	100% at 5 years	MDA 7.4

Abbreviations: NR: not reported; EPR: endoprosthetic replacement; PJI: periprosthetic joint infection; HHS: Harris Hip Score; MDA: Merle d'Aubigne Score; TESS: Toronto Extremity Salvage Score; OHS: Oxford Hip Score; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

Silver coating can be an additional weapon to fight PJIs or to prevent their onset in higher-risk patients. The efficacy and safety of silver has been reported in several in vitro and animal studies [32,33]. A recent systematic review found that silver coating of MP appears to provide more benefit when used in a revision surgery setting, in particular in the treatment of PJIs for prevention of recurrence, rather than as primary prophylaxis [102]. This review reported that the use of a silver-coated MP reduces the re-infection rate in revision surgery for PJI from 30% to 13% compared to when an uncoated MP is used [102]. However, most of the data available refer to MP around the knee. Hardes et al. reported lower infection rates when using silver-coated PF MPs than when using titanium ones, at 4.5% versus 18.5%, respectively [103,104]. A possible disadvantage of silver coating is the cost, but there are currently no studies that have thoroughly investigated the cost–benefit ratio of these implants, especially with regard to the possibility of cost recovery through increased efficacy in reducing the number of additional hospitalizations for infection.

4. Conclusions

THA revision is not the main indication for the use of megaprostheses or custom-made pelvis prostheses. However, we observed that in extreme bone defects, the combination of a proximal femur megaprosthesis and a custom-made prosthesis on the acetabular side can be considered a good salvage option. The reported patients resumed their daily life activities without any complication related to the surgery. In similar cases, silver coating should be considered on both sides to reduce the risk of infection. Our experience based on these two cases provides a starting point for future evaluation of the real advantages of this surgical strategy and, consequently, for a wise analysis of its cost–benefit ratio.

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