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HIP

Clinical outcome in total hip arthroplasty for septic sequelae in childhood

A RETROSPECTIVE STUDY

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Aims

Adult patients with history of childhood infection pose a surgical challenge for total hip arthroplasty (THA) due to distorted bony anatomy, soft-tissue contractures, risk of reinfection, and relatively younger age. Therefore, the purpose of the present study was to determine clinical outcome, reinfection rate, and complications in patients with septic sequelae after THA.

Methods

A retrospective analysis was conducted of 91 cementless THAs (57 male and 34 female) performed between 2008 and 2017 in patients who had history of hip infection during childhood. Clinical outcome was measured using Harris Hip Score (HHS) and Modified Merle d'Aubigne and Postel (MAP) score, and quality of life (QOL) using 12-Item Short Form Health Survey Questionnaire (SF-12) components: Physical Component Score (PCS) and Mental Component Score (MCS); limb length discrepancy (LLD) and radiological assessment of the prosthesis was performed at the latest follow-up. Reinfection and revision surgery after THA for any reason was documented.

Results

There was significant improvement in HHS, Modified Merle d'Aubigne Postel hip score, and QOL index SF 12-PCS and MCS ($p < 0.001$) and there was no case of reinfection reported during the follow-up. The minimum follow-up for the study was three years with a mean of 6.5 (SD 2.3; 3 to 12). LLD decreased from a mean of 3.3 cm (SD 1) to 0.9 cm (SD 0.8) during follow-up. One patient required revision surgery for femoral component loosening. Kaplan-Meier survival analysis estimated revision-free survivorship of 100% at the end of five years and 96.9% (95% confidence interval 79.8 to 99.6) at the end of ten years.

Conclusion

We found that cementless THA results in good to excellent functional outcomes in patients with a prior history of childhood infection. There is an exceedingly low rate of risk of reinfection in these patients, even though complications are not uncommon.

Cite this article: *Bone Jt Open* 2022;3-4:314–320.

Keywords: Total hip arthroplasty, Septic, Reinfection, Clinical, Complications

Introduction

The incidence of septic arthritis in developing countries is about 1:20,000, and the hip is the most common site.[1] The outcome is dependent on early diagnosis and aggressive treatment in the form of proper antibiotic usage and surgical decompression. If left untreated, septic arthritis of the hip poses surgical challenges due to anatomical deformation of bone and soft-tissue contractures. Anatomical deformation includes presence of abnormal location of hip centre, limb length discrepancy (LLD), a small acetabulum and femoral canal, and increased femoral anteversion.[2] Total hip arthroplasty (THA) is the treatment of choice to mitigate pain and improve quality of life in these patients. A quiescent period of more than ten years has been advocated to alleviate the risk of reinfection.[3-5] The

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doi: 10.1302/2633-1462.34.BJO-2022-0015.R1

Bone Jt Open 2022;3-4:314–320.

Table I. Descriptive statistics of clinical outcome preoperatively and postoperatively (n = 91). All p-values were < 0.001.

Outcome	Preoperative	Latest follow-up
Mean Harris Hip Score (SD)*	48.2 (10.9)	87 (5.1)
Rating, number of hips		
Excellent (90 to 100 points)	0	39
Good (80 to 89 points)	0	45
Fair (70 to 79 points)	0	7
Poor (< 70 points)	91	0
Mean Modified MAP (SD)*	7.6 (1.8)	16.7 (1.32)
Mean SF-12 PCS (SD)*	9 (1.73)	21.1 (2)
Mean SF-12 MCS (SD)*	13.6 (3)	25.7 (2.6)
Mean LLD, cm†	3.3 (1)	0.9 (0.8)
Distribution, number of hips		
≤ 1	1	54
> 1 to 2	15	27
> 2 to 3	19	10
> 3 to 4	34	0
> 4 to 5	13	0
> 5	9	0

*Paired *t*-test.
†Wilcoxon signed-rank test.
LLD, limb length discrepancy; MAP, Merle d'Aubigne and Postel score; MCS, Mental Component Score; PCS, Physical Component Score; SD, standard deviation; SF-12, 12-Item Short Form Health Survey Questionnaire.

challenge of operating on hips secondary to childhood infection remains substantial. A high risk of complications associated with this subset of patients, such as intraoperative femoral fractures, postoperative deep infection, sciatic and femoral nerve injury, mechanical loosening, and revision, has been reported with THA in these patients.[3-8] Subtrochanteric osteotomy and extensive soft-tissue releases are often required in these patients to facilitate joint reduction and decrease the risk of neurovascular injury.[9]

There is always an easy assumption that THAs for septic sequelae may have an increased risk of reinfection. This is due to a relatively younger age group, presence of dysplastic acetabulum and proximal femur, along with poor bone stock, which can lead to an increased risk of complications during THA, and may impair its long-term success and increase risk of revision.[10] There are only limited studies covering this subset of patients, with varied results.[3-8,10-13] Therefore, the purpose of the present study was to determine the clinical outcome, reinfection rate, and complications in patients with septic sequelae after THA.

Methods

A retrospective record analysis of patients from January 2008 to December 2017, who underwent primary cementless THA in a university teaching hospital for end-stage arthritis secondary to childhood infection, was conducted after obtaining Institution Review Board approval for the study. Informed consent was obtained from the patients after explaining the study to them. A total of 95 patients were identified from our longitudinally maintained total joint registry. Four patients were lost to follow-up; 91 patients (57 male and 34 female, all unilateral) were recruited for the study. The inclusion criteria included history of acute pyogenic infection of hip during childhood with at least ten years of quiescent period of infection, sinus and scar formation, and secondary osteoarthritis (OA) of hip and minimum follow-up of three years post-THA. Exclusion criteria included history of tuberculosis or fungal infection, or loss to follow-up. The indication to perform THA included pain not responding to conservative treatment, along with stiffness and poor quality of life, and the contraindications included painless stable hip and presence of active infection.

The mean age at the time of contraction of original infection was 5.2 years (standard deviation (SD) 2; 2 to 10). The mean time interval between active infection and THA was 23.9 years (SD 4.2; 11 to 35). The mean age at the time of index THA was 29.1 years (SD 6.4; 18 to 44). The patients were followed until latest follow-up, or revision of any component. The mean follow-up was 6.5 years (SD 2.3; 3 to 12). In most cases, the authors were not able to glean information about the type of bacterium that caused infection in childhood. A total of 63 patients had more than one surgery in childhood, while the remaining patients had one or no surgery for septic arthritis in childhood. No patient in our study group had prior metal hardware in situ. All preoperative investigations were within normal limits in all the patients. Intraoperative cultures and frozen section were negative for any bacterial or tuberculosis infection. On the basis of preoperative radiograph; three sub-types were indentified: dislocation, ankylosis, or arthritis. There were 53 hips with dislocation, 12 hips with ankylosis, and the other 26 hips were arthritis. All the dislocating hips were either Crowe III/IV.

Before proceeding for THA, the infection work-up was done preoperatively in all patients, which included ESR, CRP, and hip aspiration. If all of these were negative, the patient was scheduled for THA. As a part of routine protocol for any surgery with history of infection, specimens were taken from five different locations from the deep tissue and cultured for aerobic, anerobic, and tubercle bacilli using five different sets of instruments. Suspicious tissues were sampled for frozen sections intraoperatively. After obtaining specimens for culture, a twice-daily dose of 1.5 g cefuroxime was administered intravenously for five days as part of our institute protocol for these patients.

Single-stage cementless THA was performed using posterolateral approach by a single surgeon (RM). All osteophytes and intra-articular scar tissue were removed

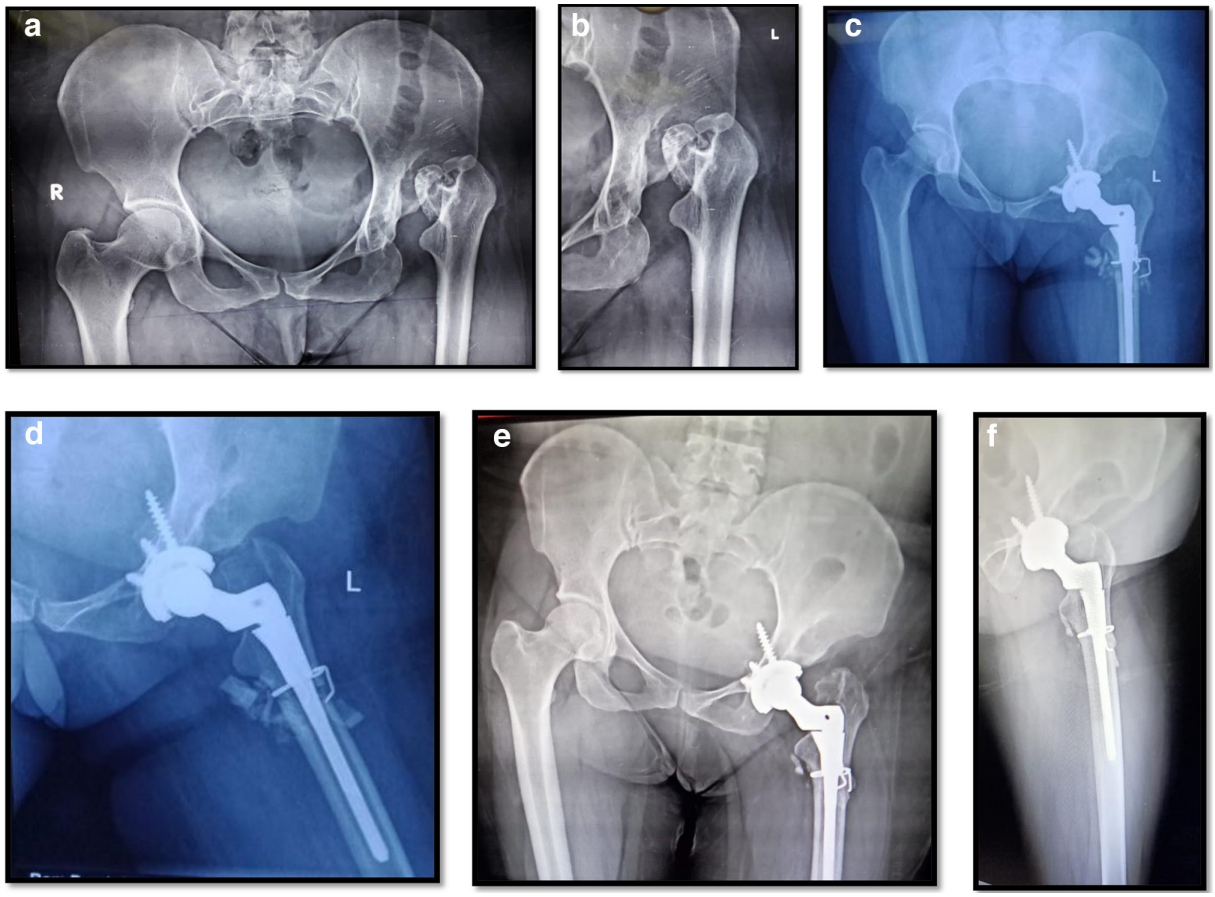

Fig. 1

a) Preoperative anterioposterior (AP) radiograph showing the dislocating type of hip following septic arthritis. b) Preoperative lateral radiograph showing the dislocating type of hip following septic arthritis. c) Postoperative AP radiograph showing total hip arthroplasty (THA) along with subtrochanteric osteotomy. d) Postoperative lateral view showing THA in situ. e) Follow-up AP radiograph showing well-fixed prosthesis and union of osteotomy site. f) Follow-up lateral radiological showing well-fixed prosthesis and union of osteotomy site.

prior to the release of contracted soft-tissue. Acetabular component was placed in the true acetabulum with maximum available bone coverage. In all cases, we tried to keep hip centre within 5 mm of native hip centre. A single remnant of femoral head was used to supplement the acetabulum in 20 cases of deficient acetabulum to enhance cup coverage. The median diameter of acetabular shell used was 48 mm (interquartile range (IQR) 48 to 50). The acetabular component used was Pinnacle (Depuy Synthes, USA) in 58 hips, Plasma cup (Aesculap, Germany) in 19 hips, and Trilogy IT (Zimmer, USA) in 14 hips. The size of femoral head used was 22 mm (metal) in five hips, 28 mm (ceramic) in 39 hips, 32 mm (ceramic) in 40 hips, and 36 mm (ceramic) in 7 hips. Ceramic liner was used in 26 patients, whereas highly cross-linked polyethylene liner was used in 65 patients. Femoral stem was inserted using press-fit technique. The stem used was S-ROM (Depuy Synthes) in 62 hips, Metha (Aesculap) in 19 hips, and Taperlock (Zimmer) in ten hips. Subtrochanteric femoral osteotomy was considered when even after the release of iliopsoas, adductor, and pie-crusting iliotibial tract, the hip was not reducible or the sciatic nerve was taut after trial reduction. This was required in 48 patients. Subtrochanteric femoral osteotomy was performed 1 to 2 cm below lesser trochanter, and the amount of femur resected was based on preoperative LLD and intraoperative telescoping. Percutaneous adductor tenotomy was necessary in 65 patients. All patients were encouraged to mobilize on the day of surgery.

Preoperative clinical and radiological outcomes were evaluated from our patient record database. All patients were reviewed for the presence of reinfection during follow-up. Clinical evaluation was performed using the Harris Hip Score,[14] and Modified Merle d'Aubigne Postel (MAP)[15] score at one month, three months, and six months after THA, and annually thereafter. At the latest follow-up, severity of limping was assessed with a view to whether a walking aid such as a cane, crutch, or walker was needed. The 12-Item Short Form Health Survey Questionnaire (SF-12) components - Physical Component Score (PCS) and Mental Component Score (MCS)

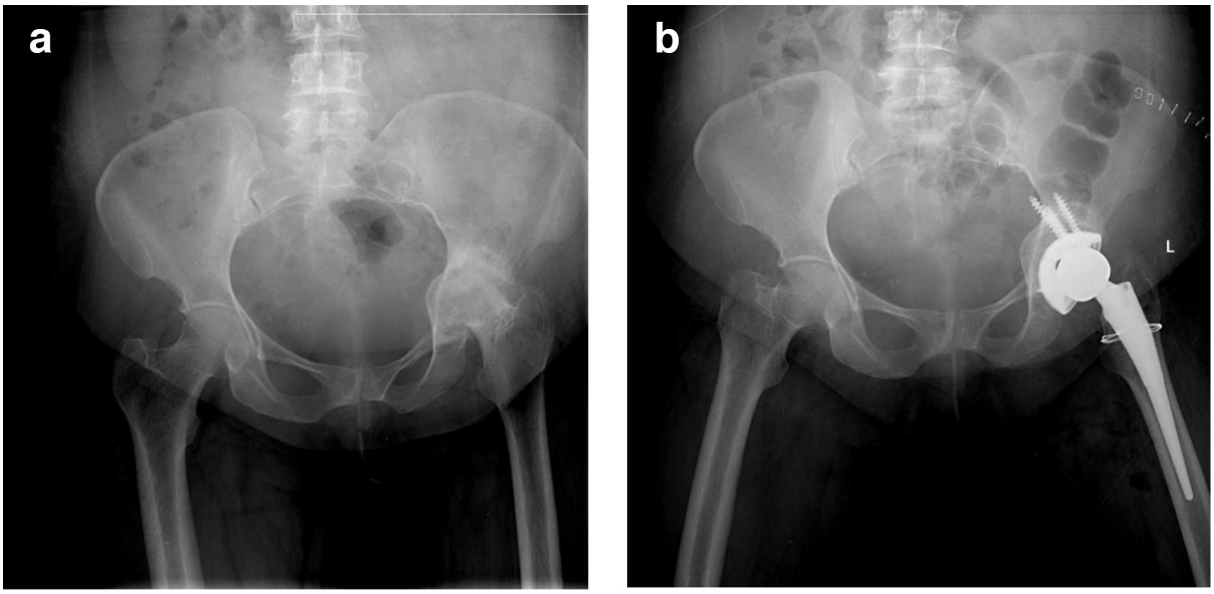

Fig. 2

a) Preoperative anterior-posterior radiograph showing unilateral osteoarthritis secondary to pyogenic infection. b) Postoperative radiograph showing total hip arthroplasty and intraoperative femoral fracture managed with wire cerclage.

- were used to assess QOL preoperatively and postoperatively at the latest follow-up. LLD was calculated preoperatively and postoperatively after squaring the pelvis and measurement from the anterior superior iliac spine to medial malleolus. Postoperative radiological evaluation included fixation of acetabular component and femoral stem at every follow-up visit. Femoral stem stability was measured using Engh classification[16] for fixation as bone ingrowth, fibrous stable or loose, Gruen classification for osteolysis,[17] Callaghan for stem subsidence,[18] and Masonis[8] classification for healing at osteotomy site. Brooker classification was used for heterotopic ossification.[19] Radiolucent lines around acetabulum and fixation were assessed using DeLee and Charnley classification.[20] Complications during the surgery were reviewed from the patient database, and were followed in the postoperative period for development of any complications such as deep vein thrombosis, dislocation, periprosthetic fracture, or sciatic or femoral nerve palsy. Revision of any component was taken as the endpoint for the study participant.

Statistical analysis. Baseline characteristics were described for each patient using mean and standard deviation, (SD), median (IQR), or frequencies/percentages as appropriate. Preoperative and postoperative continuous variable were assessed using paired *t*-test and Mann-Whitney U test as applicable. All analyses were conducted using Stata v. 14.0 (Stata Corp, USA). A p-value < 0.05 was considered statistically significant. Kaplan-Meier survival analysis was used to assess implant survivorship, with revision being the endpoint.

Results

The mean preoperative Harris Hip Score was 48.2 points (SD 10.88; 31 to 65) and it improved to 87 points (SD 5.11; 71 to 91) ($p < 0.001$, paired *t*-test) at the latest follow-up. MAP hip score improved significantly from a mean of 7.6 (SD 1.8; 3 to 11) to 16.7 (SD 1.32; 13 to 18) ($p < 0.001$, paired *t*-test). Quality of life index SF 12-PCS and MCS showed significant improvement from a mean of 9 (SD 1.73; 5 to 12) and 13.6 (SD 3; 18 to 25) to 21.1 (SD 1.99; 8 to 18) and 25.7 (SD 2.59; 21 to 29), respectively ($p < 0.001$, paired *t*-test). Preoperative LLD was 3.3 (SD 1; 1 to 5.4), while postoperative LLD was 0.9 cm (SD 0.8; 0 to 3) at the latest follow-up (Table I). Out of 91 patients, 19 patients had LLD of more than 1.5 cm at the latest follow-up. Five patients complained of shorter limb on the operated side at one-month follow-up, but this was not appreciable on physical examination. A total of 32 patients used assistance for walking either in the form of a cane, crutch, or walker at the final follow-up. There was no difference in clinical outcome in type of arthritis apart from greater usage of walking aid in the dislocating type. The ankylosis and arthritis groups were equally challenging due to presence of extensive soft-tissue contractures and stiffness. No patient had any evidence of reinfection in the postoperative or follow-up period. Most of the cases had placement of modular stem due to frequent need of reduction osteotomy; the rest of the cases were managed with either a short or standard stem on the basis of the patient's affordability. There was no difference in clinical outcome on the basis of different implants used. Type of bearing surfaces

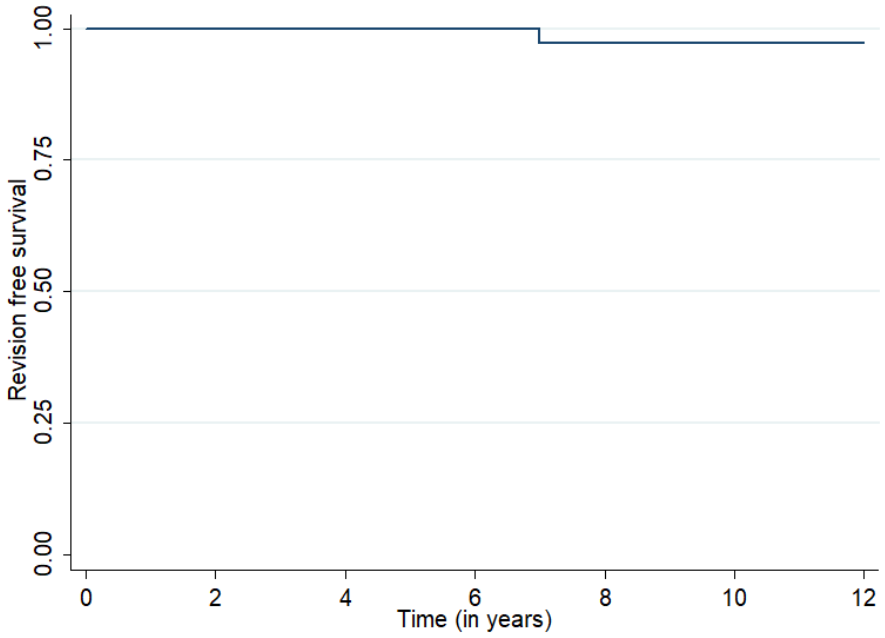

Fig. 3

Kaplan-Meier analysis showing revision-free survival analysis. Numbers at risk: 91 (3 yrs), 77 (5 yrs), 14 (10 yrs), and 2 (12 yrs).

had no impact on the functional outcome. The mean amount of shortening done in our cases was 2.6 cm (SD 0.5). More than 95% of the patients showed satisfactory position of both acetabular and femoral components. All the osteotomy sites showed bony union. Femoral components showed stable bony ingrowth at the latest follow-up. There was evidence of progressive radiolucent lines along the femoral component in one patient, which led to loosening of the stem. At the latest follow-up, all the acetabular components were found to be stable (Figure 1).

Intraoperative femoral fractures occurred in two patients, which was managed with wire cerclage and healed without any evidence of prosthetic loosening (Figures 2a and 2b). Two cases of transient sciatic nerve palsy were seen, which recovered gradually over a period of six months with rehabilitation. No patient developed dislocation, periprosthetic fracture, deep vein thrombosis, or femoral nerve palsy. Six patients had heterotopic ossification in the follow-up period, out of which four were class I according to the Brooker classification system, whereas the rest were class II.

Kaplan-Meier survival analysis estimated revision-free survivorship of 100% at the end of five years and 96.9% (95% confidence interval 79.8 to 99.6) at the end of ten years (Figure 3). At final follow-up, one patient had undergone revision surgery (1.1%) for femoral component loosening; the patient recovered well postoperatively.

Discussion

THA secondary to septic sequelae poses a surgical challenge to orthopaedic surgeons due to the risk of reactivation of infection.[21] It is difficult to reduce and maintain the femoral head in the native acetabulum due to the presence of soft-tissue contractures, bony abnormalities, and deficient bone stock.[10] History of previous surgeries and metal hardware in situ further increase the complexity of index THA. and there always remains a chance of incomplete recovery in these patients.[22] There is also always a high risk of complications associated with THA in this subset of patients, such as sciatic nerve injury, periprosthetic fractures, LLD, and mechanical loosening.[3-8] Considering all these risks, there is a quandary as to whether or not THA should be performed in this subset of patients. Various studies have reported good to excellent outcomes if THA is performed after a period of quiescence of more than ten years.[5,7,10-13] The results of the present study are consistent with other published studies, and further strengthen the existing evidence (Table II).[5,7,23–27]

There was substantial pain relief and functional improvement after THA at an average follow-up of 6.5 years, as demonstrated by improvement in clinical scores and quality of life indices. The lower preoperative score suggests a greater chance of improvement after THA. One-third of patients in our study complained of limping postoperatively, which could be attributed to extensive soft-tissue release during surgery and a low threshold for reduction osteotomy. Improved quality of life indices after THA suggest patient expectations were

Table II. Descriptive summary of studies with total hip arthroplasty for septic sequelae.

Study	Hips, n	Average time interval between presentation and operation, yrs	Average follow-up, yrs	Rate of postoperative infection, %	Complications
Our study	91	24	6.5	0	1 case of femoral component loosening, heterotropic ossification (6)
Qian et al[27]	45	38	6.1	0	Aseptic loosening (2), periprosthetic fracture (3)
Luo et al[7]	101	24	6.25	0	Heterotopic ossification (5), dislocation (4), osteolysis (19), femoral fracture (7)
Papanna et al[26]	7	4	5.5	0	Heterotopic ossification (2), dislocation (1)
Kim et al[5]	170	33	10.3	1.2	Heterotopic ossification (16), dislocation (0), osteolysis (97), femoral fracture (3)
Bauer et al[23]	9	5	5	0	Not provided
Laforgia et al[25]	42	33	5	9.5	Not provided
Jupiter et al[24]	24	27	3.5	4.2	Not provided

met, and they were able to perform activities of daily living.

In a systematic review published by D'Apolito et al,[28] pooled reinfection rate after THA in septic sequelae was 1%, whereas it had decreased to 0.7% for the studies published in the last ten years. There was not even a single case of reinfection after THA in the follow-up period in the present study. Various causes could be attributed to this, such as a long quiescent period of more than ten years following an initial infection during childhood, normal preoperative inflammatory markers, aspiration, absence of any organism on frozen section or cultured samples, and use of cementless THA.

There were two cases of femoral fracture (2%) in the present study managed with wire cerclage, with subsequent follow-up showing no evidence of loosening. Due to presence of narrow canal and poor bone quality in the proximal femur, there is always a chance of intraoperative femoral fracture during insertion of definitive femoral stem. These cases require a good amount of preoperative planning and accurate implant selection to avoid such iatrogenic complications. Some authors have advocated placement of cerclage prior to insertion of femoral stem.[14] Sciatic nerve damage can occur while placing acetabulum in original hip centre due to longstanding nature of septic sequelae and severe soft-tissue contracture. The senior surgeon (RM) had a low threshold for osteotomy if on palpation the nerve was found to be taut; nonetheless, the authors observed two cases of transient sciatic nerve palsy (2%), which recovered completely at the latest follow-up. No correlation was established between leg-lengthening and sciatic nerve injury, although a LLD of more than 3.5 cm should be accompanied by a shortening osteotomy and tailored soft-tissue release, to restore anatomical hip centre and avoid nerve palsy. The incidence of heterotopic ossification was 6.6% which was consistent with existing literature.[28]

Anatomical placement of acetabular component and press-fit femoral stem placement are key to long-term survivorship of THA. Revision-free survival analysis was 100% at five years and 96.9% at ten years. In the present study, there was one case of femoral component revision (1.1%), probably due to suboptimal distal fixation. The revision rate is lower than the pooled revision rate (8%) across various studies, although the mean follow-up in our study is lower than these published studies.[28] The lower rate could be attributed to accurate placement of acetabular component in all cases, and the use of newer bearing surfaces such as highly-cross linked polyethylene, ceramic liners, and ceramic head for these younger patients. Furthermore, Indian patients do not perform high-impact sporting activites to the same extent as a Western population, leading to less polyethylene wear. The modular S-ROM stem provides all the options of modularity for version, small diameter stems, and rotational stability in case of subtrochanteric osteotomy. Our institute is a high-volume joint arthroplasty centre with loss to follow-up being less than 5%, so the patient is unlikely to go elsewhere if they develop complications, which lowers the risk of transfer bias. All these indicate benefits of intervention in these patients.

There are some inherent limitations to the present study, such as single-centre data with no control group, and its retrospective nature, which can cause information and recall bias. Assessment bias can occur, as a single surgeon (RM) performed all the surgeries and was the sole member to decide the revision of index THA, thus leading to selection bias. Additionally, no data were available regarding the type of organism that caused the original infection; our results pertain only to bacterial septic arthritis, as mycobacterial tuberculosis infection was not considered. No competing risk analysis was done for revision apart from aseptic loosening, and no attempt was made to measure acetabular inclination and version. Caution needs to be applied as longer follow-up could have resulted in varied outcome.

Overall, we found that cementless THA results in good to excellent functional outcomes in patients with a history of childhood infection. Preoperative inflammatory

markers and intraoperative frozen section are imperative to detect any indolent or occult infections. There is an exceedingly low rate of risk of reinfection in these patients, even though complications are not uncommon. The risk of complications can be mitigated by preoperative templating, adequate soft-tissue release, and a low threshold for subtrochanteric osteotomy. Further research is warranted in terms of a prospective multicentre study design with long-term survival analysis, antibiotic regimen, and implant choice.

Take home message

- Cementless total hip arthroplasty results in good to excellent outcomes in patients with a history of childhood infection.

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Funding statement:
- The authors received no financial or material support for the research, authorship, and/or publication of this article.

ICMJE COI statement:
- On behalf of all authors, the corresponding author states that there is no conflict of interest.

Data sharing:
- The data has been uploaded as supplementary material. If more data is required, it will be provided upon request.

Ethical review statement:
- All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Institutional Ethical clearance was taken and Reference no is IEC-495/05.06.2020. Informed consent was obtained from all the individual participants included in the study. The participants had consented to the submission of the manuscript to the journal. Patients signed informed consent regarding publishing their data.

Open access funding
- The authors confirm that the open access fee for this study was self-funded.