

Short-term outcomes of one-stage bilateral total hip arthroplasty in young patients (< 30 years old)

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Abstract

Total hip arthroplasty is one of the best treatments for restoring function and activity in young patients with advanced joint diseases. One-Stage Bilateral Total Hip Arthroplasty (BTHA) offers many advantages, which are important to younger patients and diminished costs and time in comparison with sequential THA. There is currently much concern about the safety of this procedure. The current study was designed to provide more information regarding THA in patients aged 30 years old or younger. Between April 2010 and September 2015, arthroplasty procedures were performed on 180 patients at the surgical centers of Erfan and Milad, Tehran, Iran. The patients that were entered in the study included those with bilateral hip involvement of Avascular Necrosis (AVN), Rheumatoid Arthritis (RA), Juvenile Rheumatoid Arthritis (JRA), Slipped Capital Femoral Epiphysis (SCFE), and Developmental Dysplasia of the Hip (DDH). The patients underwent one-stage bilateral total hip arthroplasties through the direct lateral approach. Standardized questionnaires were used to obtain mean Postel-Merle d'Aubigné (PMA) score, Oxford Hip Score (OHS), Visual Analogue Scale (VAS) Score, and Modified Harris Hip Score (MHHS), both preoperatively and post-operatively to evaluate functional outcomes. All patients were in the American Society of Anesthesiology (ASA) category 1 or 2. All complications were followed closely for a period of 4.67±0.54 years. From 141 males and 39 females, 84 patients had been recognized as ASA 1, and 96 as ASA 2. Mean age of patients was 27.04±2.74 years old (range: 16 to 30). The mean operation time and the average length of hospital stay were 156±23 minutes and 5.20±2.44 days, respectively. Overall, 3 patients developed unilateral temporary peroneal nerve palsy (1.66%), 2 intra-operative fracture (1.11%), and 2 patients (1.11%) showed deep vein thrombosis. There

was no wound infection. Regarding the functional scores in the diagnosis of patients, improvement was better in AVN than, RA, JRA, SCFE, and DDH, respectively. There were significant differences between diagnosis and every functional score, individually ($P<0.05$). The current results showed that one-stage bilateral THA led to improvement in hip function and stable implant fixation at short to midterm follow up, which suggests the efficacy of one-stage cementless THA in bilateral advanced arthritis in patients younger than 30 years old.

Introduction

Total Hip Arthroplasty (THA) is a successful and cost-beneficial surgical treatment and has been shown to improve and decrease the complications in patients with advanced joint destruction.¹⁻³ One-stage Bilateral Total Hip Arthroplasty (BTHA) offers the benefits of one-session anaesthetic risks, a shorter recovery period, which is important for younger patients, and decreased costs.^{4,5} However, there are concerns about the safety of the procedure, since higher complications have been reported.⁶ Also, other studies have indicated that one-stage BTHA is effective in pain relief and restoration of the function of patients with bilateral hip arthritis without any significant increased risks.^{4,5,7-11} In the United States, there has been a growing demand for primary THA procedures, and it has been forecasted that over half a million procedures will be done by year 2030.^{12,13} The number of young patients undergoing THA is gradually decreasing due to early diagnosis and effective treatment of the underlying disease. The reported outcomes of THA in young patients are poorer compared with older patients, with a 10-year survival rate ranging from 49% to 95% in the published literature.¹⁴⁻¹⁶ Revision rate of juvenile arthritis is high and its main cause is aseptic loosening.^{17,18} Some causes of poor survival rate of prosthesis in young patients that have undergone THA are underlying conditions, such as rheumatoid arthritis and congenital hip disease, associated with significant musculoskeletal deficiencies and deformities, higher activity, use of cemented components in the early years, and common use of screws in acetabular designs.^{19,20} Total Hip Arthroplasty is one of the best treatments for restoring function and activity yet the majority of published studies on THA in young patients have focused on the treatment of Juvenile Rheumatoid Arthritis (JRA) and have primarily included cemented implants and pro-

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cedures performed in the 1980s.^{17,21} Hence, the current study was designed to provide more information in regards to THA in patients 30 years of age or younger.

Materials and Methods

Patients

Between April 2010 and September 2015, arthroplasty procedures were performed on 180 patients at the surgical centre of Erfan hospital, Tehran, Iran. Patients with bilateral hip involvement of Avascular Necrosis (AVN), Rheumatoid Arthritis (RA), Juvenile Rheumatoid Arthritis (JRA), Slipped Capital Femoral Epiphysis (SCFE), and Developmental Dysplasia of the Hip (DDH) were included in an observational prospective study. The cases underwent one-stage bilateral total hip arthroplasties through the direct lateral approach. All of these 180 patients were American Society of Anaesthesiologists (ASA) class I or II. They underwent one-stage bilateral total hip arthroplasties through the direct lateral approach (Hardinge approach). The following data were evaluated for every patient: hospital stay duration, operation time, pre-operative and postoperative haemoglobin levels, vital status, and complications such as pulmonary embolism, surgical site infection, dislocation, peroneal nerve palsy, deep

venous thrombosis, revision, and other intraoperative and postoperative complications. To assess patient quality of life and hip function, standardized questionnaires were completed by the patients to obtain mean scores of Postel-Merle d'Aubigné (PMA) score,²² Oxford Hip Score (OHS),²³ Visual Analogue Scale (VAS) score, and Modified Harris Hip Score (MHHS),²⁴ both preoperatively and post-operatively.

Inclusion and exclusion criteria

The described procedure was employed for patients with ASA 1 or 2, without any evidence of infection. Patients with a history of hip fusion and ASA category 3 or greater were excluded from the study. From a total of 141 males and 39 females, 84 patients were recognised with ASA 1, and 96 with ASA 2. Mean age of patients was 27.04±2.74 years old (range: 16 to 30). Overall, 102 patients were diagnosed with AVN of femoral neck, 21 patients with RA, 21 patients with JRA, 30 patients with DDH, including 18 patients with Crowe type II and 12 patients with Crowe type III, and 6 patients with SCFE. Demographic data of patients are summarized in Table 1.

Surgical procedures and Prosthesis

The standard direct lateral Hardinge approach was used for all patients. One surgical team and the same main surgeon (senior author of the article) performed the hip replacements (Figure 1). General anaesthesia was used for 117 patients, spinal anaesthesia for 42 patients, and epidural anaesthesia for 21 patients. Pelvic radiograph was obtained, at the end of each procedure. Continuum cup (Zimmer, Warsaw, IN, USA), M/L Taper femoral stem prosthesis (Zimmer, Warsaw, IN, USA), and ceramic femoral head (Zimmer, Warsaw, IN, USA) were used for all patients. All of the prostheses were cementless. Preoperative prophylaxis against infection was given to all patients (1 g cefazolin, intravenously, before the surgery followed by 1 g, three times daily for the first day). Subcutaneous low molecular weight heparin (40 mg once daily) starting on the day of surgery was given to all patients for 14 days in addition to anti-embolism stockings as prophylaxis against Deep Vein Thrombosis (DVT). Early mobilization was used both to prevent DVT and to hasten the functional recovery. Full weight-bearing was allowed from the day after surgery with walker in all cases. All subjects used a walker for the first 3 weeks and physiotherapy was performed for the outpatients during the first week.

Follow-up

The current study evaluated all patients clinically and radiologically with serial follow-ups to determine the complications. The following parameters were monitored during the procedure and follow-up: Length of hospital stay, operative time, preoperative and postoperative hemoglobin levels, vital status, complications (such as pulmonary embolism, surgical site infection, dislocation, and revision), and other intra-

operative and postoperative complications. Data forms were used to record the details of the procedure, including estimated blood loss, duration of the procedure, and other information. Recording and analysis of perioperative medical and surgical complications were performed. All complications during the hospital stay were evaluated, and patients were followed closely for a period of 4.67±0.54 years.

Complications of each joint, including

Table 1. Demographic characteristics of patients.

Variable	N (%)
Patient number	180 (100)
Gender	
Male	141 (78.3)
Female	39 (21.7)
Age	
15-20	3 (1.6)
20-25	21 (11.6)
25-30	156 (86.8)
ASA classification	
Class I	84 (46.6)
Class II	96 (53.4)
Diagnosis	
Avascular necrosis	102 (56.6)
Rheumatoid arthritis	21 (11.6)
Juvenile rheumatoid arthritis	21 (11.6)
Developmental dysplasia of the hip - Crowe type I	18 (10)
Developmental dysplasia of the hip - Crowe type II	12 (6.6)
Slipped capital femoral epiphysis	6 (3.6)

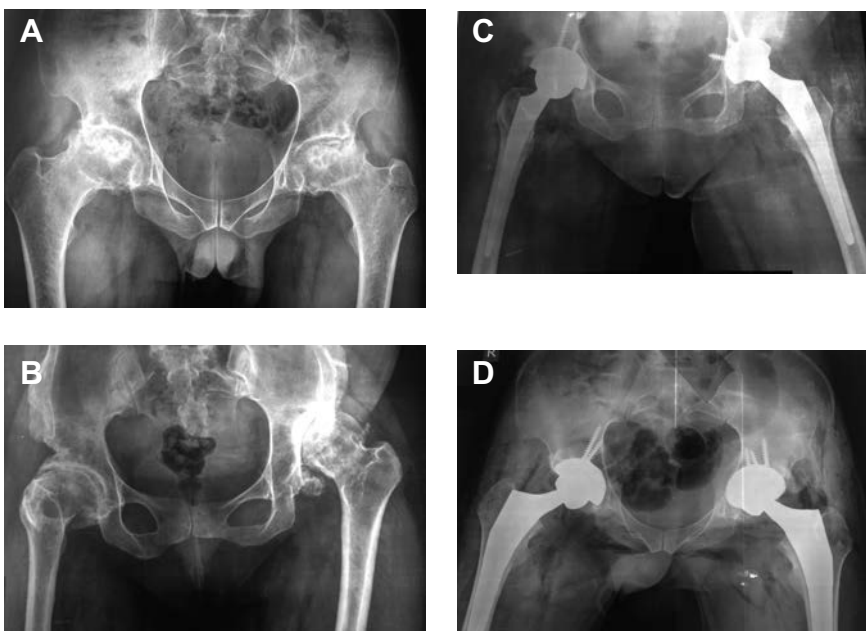


Figure 1. Pre and post-operation X-rays of and Developmental Dysplasia of the Hip (DDH) and Avascular Necrosis (AVN) cases; A) pre-operation X-ray of DDH, B) pre-operation X-ray of AVN, C) post-operation X-ray of DDH, D) post-operation X-ray of AVN.

fracture, dislocation, superficial wound infection, deep wound infection around the prosthesis, and incidence of heterotopic ossification were recorded. Systemic complications, including cardiac and gastrointestinal complications, cerebrovascular accidents, phlebitis/pulmonary embolism, and urinary tract infection were also noted. Any other complications and the details of any revision procedure were also noted.

Statistical analysis

Descriptive statistical analyses were used to present mean and standard deviation of quantitative variables. Paired sample t-test, independent t-test, and Chi-square test were used with 95% confidence limits. For all analyses, the SPSS (SPSS 21.0 for Windows; SPSS Inc. Chicago, Illinois) software was used. P-values of less than 0.05 were considered significant.

Ethics

The researchers considered all ethical issues for patient's information and procedures based on the ethical committee of Tehran branch of Azad University and ethical statements. Informed consent was obtained from each individual prior to surgery, and patients were fully informed of the potential benefits and complications of the procedures.

Results

The mean operation time and the average length of hospital stay was 156±23 minutes and 5.20±2.44 days, respectively. There was no reported patient with perioperative death, pulmonary embolism, dislocation or heterotrophic ossification. No patient required reoperation or revision. There were 3 patients that developed unilateral, temporary peroneal nerve palsy (1.66%), which resolved after 3 months in all cases. Also, 2 JRA patients (1.11%) with

intra-operative fracture were reported. There were 2 patients (1.11%) with deep vein thrombosis, whose complications were resolved after treatment. There was no superficial or deep wound infection. Infection around the prosthesis and incidence of heterotopic ossification were not reported. Systemic complications, including cardiac and gastrointestinal complications, cerebrovascular accidents, phlebitis/pulmonary embolism, and urinary tract infection were not detected. List of complications is presented in Table 2. There was no significant relationship between occurrence of complications and ASA category ($P>0.05$). Loosening in radiological follow

ups in acetabular and femoral stem components was not found in the current study.

The mean Postel Merle d'Aubigne's score, Oxford Hip Score, Visual Analogue Scale, and Harris Hip Score improved significantly by the final follow-up compared to before surgery, by approximately 8, 12, 3, and 18 points, respectively (Table 3). As indicated by Table 4, regarding the functional scores in the diagnosis of patients, improvement was better in AVN than, RA, JRA, SCFE, and DDH, respectively. There were significant differences between diagnosis and every functional score ($P<0.05$). There was no significant relationship between occurrence of complications and

Table 2. Complications after one-stage bilateral total hip arthroplasty.

Complication	N (%)
Death	0
Pulmonary embolism	0
Myocardial infarction	0
Stroke	0
Revision surgery for implant loosening	0
Proneal nerve palsy (improved after 3 month)	3 (1.66)
Deep vein thrombosis	2 (1.11)
Superficial wound infection	0
dislocation	0
Intra-operative fracture	2 (1.11)
Re-operation for piriformis syndrome	0
Heterotopic ossifications	0
Ilio-psoas irritation	0
Total	7 (3.88)

Table 3. Functional scores after one-stage bilateral total hip arthroplasty.

Outcome assessment	Pre-operative	Post-operative	P value
Postel-Merle d'Aubigné	9.25±2.90	17.51±0.80	<0.001
Oxford Hip Score	20.42±7.21	32±62.01	<0.001
Visual Analogue Scale	6.10±1.80	3.06±2.40	<0.05
Modified Harris Hip Score	45.08±14.60	84.97±19.54	<0.001

Table 4. Functional outcome score improvements according to preoperative diagnoses.

Diagnosis	PMA (mean ± SD)		OHS (mean ± SD)		VAS (mean ± SD)		MHHS (mean ± SD)	
	Pre-OP	Post-OP	Pre-OP	Post-OP	Pre-OP	Post-OP	Pre-OP	Post-OP
Avascular necrosis	8.42±1.78	18.50±0.90	19.92±5.44	33.26±4.65	6.55±1.35	2.42±1.21	47.95±12.87	85.79±15.22
Rheumatoid arthritis	7.96±0.45	17.70±0.47	19.65±3.22	32.44±5.29	6.38±1.77	3.02±2.05	42.72±13.27	84.44±16.03
Sequel of juvenile rheumatoid arthritis	8.66±1.02	17.53±1.13	18.78±4.33	32.15±6.24	7.93±2.27	3.55±1.89	46.59±12.41	83.44±16.03
Sequel of slipped capital femoral epiphysis	8.29±0.78	15.42±1.25	18.12±3.58	31.27±5.48	6.76±2.19	3.67±1.03	49.41±16.31	81.29±12.43
Sequel of developmental dysplasia of the hip	8.36±1.12	14.32±0.13	19.01±2.63	29.87±5.44	6.94±2.38	3.85±2.29	45.91±12.81	80.45±11.84

S.D: Standard Deviation; PMA: Postel-Merle d'Aubigné; Oxford Hip Score: OHS; Visual Analogue Scale: VAS; Modified Harris Hip Score: MHHS; Pre-OP: Preoperatively; Post-OP: Postoperatively

other factors considered in the study ($P>0.05$). About 94% of the patients showed willingness to undergo the same procedure again and about 91% recommended the surgical procedure to others with similar problems.

Discussion and Conclusions

Although THA was originally intended for the elderly, trends in contemporary practice indicate that an increasing number of procedures are being performed for much younger patients.^{25,26} Total Hip Arthroplasty is an essential treatment of end-stage disorders of the hip in younger patients. The majority of studies on THA in this age group trialed the efficacy of cemented THA for their treatment.^{17,20,21,27-31} The published information on THA in younger patients is limited.³²⁻³⁴ Therefore, the current research studied a large sample at 2 centers, Milad and Erfan Hospitals, to achieve more evidence-based outcomes of THA in this age group. This research attempted to overcome the limitations of previous studies and performed a study in a prospective manner to avoid missing necessary data and focus on the functional outcomes and patients' scores, using a larger population at 2 centers.

The results showed that one-stage cementless BTHA could improve the functional outcomes scores of patients with hip disorders younger than 30 years old. All of the functional outcome scores improved significantly. The results of MHHS were better than other scores, with 38 points of improvement by the last follow up. Regarding improvement of functional outcomes, AVN patients showed a better improvement in all of scores. In line with the current results, Haber and Goodman studied 29 THAs in patients with JRA and average age of 20 years, during the surgery and follow-up for an average of 4.4 years. Mean Harris hip scores in this patient cohort improved from 42 to 78 after THA.²¹ Clohisy *et al.* confirmed that THA provided major functional improvement in 95 patients with non-revised hips, aged 12 to 25 years, as Harris hip score improved from 43 to 83 points at mean follow up of 5 years.¹⁹ Bisel *et al.* reported on 37 JRA hips in patients averaging 22 years of age at the time of surgery and during follow-up for a mean of 11.3 years. They noted a mean Harris hip score improvement from 27.2 to 79.5 after THA.³⁵ Similar to the current work, Restrepo *et al.* described functional scores of modern uncemented THA in 29 hips during an average of 6.6 years. Their

patient population included a variety of diagnoses. The mean preoperative Harris hip score of 52 improved to 77 at the most recent follow up.³² Kitsoulis *et al.* evaluated the long-term outcomes of THA in 20 total hip arthroplasties in children with juvenile chronic arthritis with average age of 15.8 (range of 13 to 24) years. Their average follow-up was 9.2 (2-20) years. All patients had no pain and full functional ability. They suggested that the only disadvantage was wear of the prosthesis.²⁹ Adelani *et al.* in a systematic review reported that THAs, performed more recently, were less likely to be used for juvenile rheumatoid arthritis than previous procedures. Cementless fixation became more prevalent in later years. Although clinical outcome scores remained constant, aseptic loosening and revision rates decreased substantially with more contemporary procedures. Their evaluation demonstrated an improvement in radiographic outcomes and survivorship of THA, yet no significant differences in pain and function scores, in very young patients treated over the past 2 decades when compared with historical controls.¹⁸ Overall, the mentioned studies showed 20- to 40-point improvements in Harris hip scores after THA. In these studies, some of the cases underwent bilateral THA while all cases of the present investigation underwent bilateral THA in one-stage. The current findings showed better functional outcome scores in AVN patients than others. This can be related to greater number of cases with AVN in this study.

In the current research, there was no failure or revision (0%). Restrepo *et al.* reported a similar failure rate with cementless prostheses. There was only one revision secondary to severe polyethylene wear in their study.³² However, Clohisy *et al.* reported 7 (7%) failed procedures and revision surgery because of instability (3 hips), polyethylene wear/osteolysis (3 hips), and infection (1 hip).¹⁹ Bilsel *et al.* indicated that 3 hips (8.1%; 3 patients) in their investigation required revision.³⁵ Other studies reported failure rates and the need for revision surgery ranges from 3.2% to 21.2% at early to midterm follow up.^{30,36} In comparison with other studies, cementless total hip arthroplasty was found to confer a significant improvement in function and to have a lower rate of need for revision in younger patients with end-stage arthritis of the hip.

The current research showed that complication rate was 3.88%; 3 patients with unilateral temporary peroneal nerve palsy (1.66%), 2 patients with perioperative fracture (1.11%), 2 patients (1.11%) with deep vein thrombosis and no superficial wound infection. Kitsoulis *et al.* showed no intra-

or postoperative complications in their 20-patient sample (29). Clohisy *et al.* noted 9 (9%) major complications, all of which resolved with treatment except 1 nerve palsy with partial recovery and a persistent dysesthesia.¹⁹ Other studies reported complications sporadically and did not follow a consistent definition of complications. Restrepo *et al.* documented complications associated with 62 cemented THAs in patients with JRA, using the definition of major complication. They reported on 4 (6%) major complications, including 2 pulmonary emboli and 2 hips with severe heterotopic ossification.³⁰ The current research showed a lower complication rate than other studies with larger samples. This could indicate that cementless THA may be safer in young patients under 30 years old.

The current study did not find any loosening in radiological follow ups both in acetabular and femoral stem components. Similar to the current study, Restrepo *et al.* showed 100% fixation of femoral and acetabular components at a mean of 6.6 years of follow-up with a smaller sample with cementless THA.³² Also, Clohisy *et al.* indicated that implant fixation at a mean follow up of 55 months revealed 100% of the femoral stems and 98% of the acetabular components.¹⁹ These results demonstrated that secure implant fixation is predictably achieved with cementless implants in this patient population. In contrast, studies with similar follow-up durations for cemented implants^{30,36} have noted higher rates of radiographic loosening ranging from 25.8% to 42.3%, excluding revisions. These data suggest that fixation of cementless implants is superior to cemented fixation in this population with destructive joint disorders and the use of cementless hip reconstruction in adolescent and young adult patients undergoing one-stage bilateral THA is recommended.

Patients younger than 30 years of age with advanced hip disease are a unique population with a need for extremely long-term survivorship of prosthetic reconstructions. The aim of surgical treatment in this patient population is to provide a long-term solution with pain relief and restoration of function. The current results showed that one stage bilateral THA provides improved hip function and stable implant fixation at short to midterm follow up and cementless THA may provide long-term survivorship even in the young patient population. The current study attempted to overcome the limitations of other studies with 2 centres and a large sample. Based on the results and comparison with other studies, one-stage cementless THA is suggested in bilateral advanced arthritis in patients younger than 30 years.

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