

Early Results of Cementless versus Hybrid Total Hip Arthroplasty in Patients with Posttraumatic Osteoarthritis

AHMED ZAGHLOUL, M.Sc.; MAHMOUD S. KORKOR, M.D.; WAIL L. ABDELNABY, M.D. and AKRAM HAMMAD, M.D.

The Department of Orthopaedic Surgery, Faculty of Medicine, Mansoura University, Egypt

Abstract

Background: Various types of THA were used in treatment of different forms of osteoarthritis. In this study, we aimed to compare the early results of cementless versus hybrid Total Hip Arthroplasty (THA) in treatment of Posttraumatic Osteoarthritis (PTOA).

Aim of Study: Prospective comparative study.

Patients and Methods: Twenty two cases were included in the study and they were divided into two equal groups; group A that performed cementless THA, group B that underwent hybrid THA. Perioperative circumstances of perioperative complications, operating room time, blood transfusion requirements and length of hospital stay were reported.

Post-operative evaluation was done using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Oxford Hip Score (OHS) and Harris Hip Score (HHS).

Results: Demographic data did not differ between the three study groups ($p>0.05$). Group B showed a significantly longer operative time ($p=0.001$). However, complications rate, blood transfusion requirements and length of hospital stay did not differ between the study groups ($p>0.05$). Additionally, no statistically significant difference ($p>0.05$) was detected between groups as regard as Patient Reported Outcome Measures (PROMs).

Conclusion: Although, THA is one of the most successful and cost-effective treatment options of PTOA, no single type of THA is superior to the others in all circumstances.

Key Words: Cementless – Hybrid – Total hip arthroplasty (THA) – Posttraumatic osteoarthritis (PTOA).

Introduction

POSTTRAUMATIC Osteoarthritis (PTOA) is a common clinical problem affecting diarthrodial joints due to damage to the articular cartilage,

subchondral bone, incongruity of the articular surface or joint instability caused by an acute injury. Intraarticular fractures, meniscal tears, ligamentous injuries and chondral injuries are the main causes of PTOA [1]. Unlike idiopathic OA that occurs in old age affects specific joints such as the knee, hip and shoulder, PTOA may occur in young patients, often develops and progresses more quickly, and in accordance with joint injury [2].

The pathologic changes following joint trauma varies according to the severity of mechanical impact and tissue damage. There is a great difference between the effects of high and low-energy injuries. Pathologic process following trauma to the joint can temporally be classified into the acute post-traumatic phase and the chronic phase [3].

An increased understanding of the molecular, mechanobiological and cellular events involved in the pathogenesis of chronic PTA may open interesting perspectives concerning new therapeutic opportunities and thereby offer patients safer and more effective drugs. Preventive measures are thought to be the most effective strategy to limit the degree of acute joint damage and the eventual development of chronic PTA. Thus, the ideal therapy should include early clinical interventions during the first phases after joint injury and address several pathogenic pathways [4].

THA remains a very valuable solution for treatment of both posttraumatic arthritis that can occur after prior hip fracture surgery or failed hip fracture fixation. Modern acetabular fracture surgery techniques can result in hip preservation and excellent long-term functional outcomes in 70% to 80% of cases [5]. Higher energy fracture patterns, significant articular impaction, and failure to achieve an anatomic reduction can predispose patients to the

Correspondence to: Dr. Ahmed Zaghoul, The Department of Orthopaedic Surgery, Faculty of Medicine, Mansoura University, Egypt

development of secondary hip arthritis. In patients who are physiologically fit and have failed conservative management, THA can provide appropriate pain control and functional restoration [6].

Since THRs were introduced, there has been steady improvement in the technology associated with it, leading to better functional outcome and implant survivorship. Cemented implants achieve stability from cement-bone mechanical interlock, once the polymethylmethacrylate has cured [7], whereas cementless fixation relies on primary press-fit stability with long-term stability occurring secondary to endosteal microfractures at the time of preparation and subsequent bone ongrowth or ingrowth [8].

This study aims to compare the early results of cementless versus hybrid THA in treatment of PTOA.

Patients and Methods

Study design:

This is a prospective comparative study that was conducted at Orthopaedic Department, Mansoura University Hospital during the period between 2017 and 2019.

Patient sample:

Twenty two cases (n=22) with PTOA of the hip were included in the study. Cases were divided into two groups;

- Group A that included 11 cases who performed cementless THA.
- Group B that included 11 cases who performed hybrid THA.

Inclusion criteria:

Patients with post-traumatic OA of the hip joint (after acetabular or proximal femoral fractures).

Exclusion criteria:

- 1- Patients with infection (to be managed in staged procedures).
- 2- Patients with Rheumatoid Arthritis (RA).

Patient consent:

A written formal consent was obtained from all cases after explaining the details of the surgical procedure as well as any possible complications.

Patient preparation:

Before surgery, the patients were transferred to the operation theatre and they were connected to all noninvasive monitors. Pulse, non-invasive

arterial Blood Pressure (BP) as well as oxygen saturation were noted for every patient. Moreover, electrocardiography monitoring was enabled. All cases were preloaded with 20ml/kg Ringer's lactate. All patients were positioned in the lateral decubitus.

Procedure:

Under strict aseptic precaution, posterior approach to the hip was utilized for preparation of both the acetabulum and the femur. As regard the acetabular hardware was removed if it impedes the process of implantation. But, all the femoral hardware was removed in all cases. In group A, cementless components were used. In group B, cementless acetabular components and cemented femoral stems (Hybrid THA) in all cases except in one case where a cemented acetabular and cementless femoral component (Reverse hybrid THA) were utilized.

Perioperative complications, operating room time, blood transfusion requirements and length of hospital stay were documented for all patients.

Outcome measures:

Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Oxford Hip Score (OHS) and Harris Hip Score (HHS) were used as patient reported outcome measures (PROMs) at different time points (6 weeks, 3 months, 6 months, 1y, 2y and 3 years post-operatively).

- 1- *WOMAC*: WOMAC is a widely used measure of symptoms and physical disability originally developed for people with Osteoarthritis (OA) of the hip and/or knee [9]. The measure was developed to evaluate clinically important, patient-relevant changes in health status as a result of treatment intervention [10].
- 2- *OHS*: OHS is used to assess outcome after Total Hip Replacement (THR) by measuring patients' perceptions in adjunction to surgery. The original version from 1996 [11] was updated in 2007 introducing a new scoring system [12].
- 3- *HHS*: The HHS was developed for the assessment of the results of hip surgery, and is intended to evaluate various hip disabilities and methods of treatment in an adult population. The original version was published 1969 [13].

Statistical analysis:

Data were analyzed by SPSS software version 24. Qualitative data were expressed as number and percentage within group. Quantitively data were tested for normality using Kolmogorov Smirnov test and they were expressed as mean \pm standard

deviation or median and range. Comparison between the quantitative data of three study groups was carried out by one-way ANOVA test. Qualitative data were compared between the three groups using Chi square test. p -value <0.05 was considered significant in all used tests.

Results

Regarding demographics, there was no significant difference between the two study groups when it comes to age, sex, or BMI ($p>0.05$). These data are illustrated in (Table 1).

Table (1): Demographic data.

Demographic data	Group A (n=11)	Group B (n=11)	p -value
Age (years)	38.0±10.47	44.82±15.97	0.352
<i>Gender:</i>			
Male	10 (90.9)	9 (81.8)	0.274
Female	1 (9.1)	2 (18.2)	
BMI	29.23±4.92	27.64±4.59	0.248

Concerning the perioperative circumstances, the rate of perioperative complication rate was higher in group B (18.2 %) and (9.1%) in group A but, this change was statistically insignificant. The operative time was significantly longer in group B (p 0.001). The blood transfusion requirements were more in group B but statistically insignificant. Finally, the length of hospital stay was longer in group B and also was insignificant. These data are shown in (Table 2).

Table (2): Perioperative data.

Perioperative data	Group A (n=11)	Group B (n=11)	p -value
<i>Perioperative complications:</i>			
N (%)	1 (9.1)	2 (18.2)	0.53
<i>Operative time (min):</i>			
Range ± SD	100.7±10.3	141.7±15.1	0.001*
<i>Blood transfusion requirements (RBCS units): N (%):</i>			
0	1 (9.1)	0 (0)	0.65
1 unit	5 (45.5)	3 (27.3)	
2 units	3 (27.3)	4 (36.3)	
3 units	2 (18.2)	3 (27.3)	
4 units	0 (0)	1 (9.1)	
Mean ± SD	2±0.4	2.2±0.9	0.72
<i>Length of hospital stay (day):</i>			
Mean ± (SD)	8±1.4	8.7±2.7	0.27

As regard the post-operative outcomes, there was general improvement in post-operative scores in both groups. More improvement was detected earlier in the hybrid group up to the 6th month as regard the WOMAC score, first year in both OHS and HHS. Afterword, more betterment was reported in the cementless group; after first year concerning the WOMAC and after the 2nd year on the basis of OHS and HHS. All of these changes were statistically insignificant between the two study cohorts. These data are illustrated at (Table 3).

Table (3): Post-operative PROMs.

Post-operative PROMs	Group A (n=30)	Group B (n=30)	p -value
<i>WOMAC:</i>			
6 weeks	22.18±4.09	20.0±3.32	0.46
3 months	19.82±5.58	17.36±3.59	
6 months	17.45±5.72	15.91±3.1	
1 years	12.91±4.35	14.82±6.79	
2 years	9.36±5.3	10.45±7.78	
3 years	6.82±5.9	7.36±8.2	
<i>OHS:</i>			
6 weeks	35.0±5.39	33.64±4.57	0.44
3 months	36.45±5.37	37.27±4.24	
6 months	37.55±5.26	39.27±3.95	
1 years	39.82±5.23	41.18±4.87	
2 years	43.0±4.89	42.27±5.26	
3 years	44.45±4.13	43.82±5.29	
<i>HHS:</i>			
6 weeks	79.08±12.7	85.32±7.42	0.38
3 months	81.56±12.5	86.85±8.49	
6 months	83.24±12.25	87.98±9.09	
1 years	85.17±13.01	88.52±10.7	
2 years	89.98±10.30	86.98±13.45	
3 years	90.66±10.77	90.03±12.19	

Discussion

Despite modern fracture management techniques allowing for near anatomic reduction of those fractures, they continue to be a risk of Post-traumatic Osteoarthritis (PTOA) which may result from imperfect reduction or failed fracture fixation, missed or untreated osteochondral defects or chondrolysis due to trauma and avascular necrosis of the femoral head. Patients who develop PTOA of the hip have limited surgical options. THA is a very effective treatment option which can improve the hip function and reduce the pain in these cases, in spite of operative difficulties and high complication rate [14].

THA can also be used as a salvage for failed hip fracture surgery [15]. Revision of fixation is firstly recommended if the joint can be preserved. Reasonable clinical results with low complication rates have been documented with revision of the

Internal Fixation (IF) [16]. If the joint cannot be saved, so arthroplasty or arthrodesis is the principal surgical option. In cases of older patients with poor bone quality, arthroplasty may be preferable to revision fixation even if the joint is preserved. Rarely, resection arthroplasty should be considered in very ill patients or in uncontrollable infections [17].

The implants used to replace a hip are far more complex than they seem at first glance. Even when describing one general class of implant there are differences in materials, sizes, and insertion techniques. The designs of these implants vary in effort to optimize fixation, biomechanical function, and long-term survival [18].

The basic division between these types is the fixation method. Today there are 2 main techniques of fixation. The first great successes in Total Hip Arthroplasty (THA) came with "cemented" fixation. In attempts to overcome issues related to cemented fixation, press-fit techniques were developed, which allow bone ingrowth or ongrowth for fixation. Within both the cemented and press-fit techniques there are also many variances. The debate between cemented, cementless or hybrid THA is still ongoing and there is no general consensus about the perfect prosthesis suitable for complex primary e.g. following PTOA or even traditional THA cases [19].

To compare functional outcome of cemented and uncemented THA, a study was conducted by Goyal et al., where 50 patients of 50-80 years in which THR was indicated were included in the study. Patients were randomized into two groups with 25 cases in each group (cemented versus cementless THA). All the surgeries were done by single surgeon using posterolateral approach with a follow-up period of about 2 years. They demonstrated better pain scores in cemented group than in cementless group, which was statistically significant at 6 weeks ($p \leq 0.05$) and 3 months ($p = 0.002$) explaining better early bone integration with cemented THA and came out insignificant at 6 months ($p = 0.176$). Likewise, they reported better functional results in cemented group than in cementless group that was significant at 6 weeks ($p \leq 0.05$) and 3 months ($p = 0.011$) only. They concluded that cemented THAs are more cost effective with better short-term clinical outcomes than cementless THAs [20].

Additionally, a recent systematic review and meta-analysis of the published literature compared cemented and uncemented fixation in THA. Over-

all, there was no difference in failure (defined as revision) between the groups. Subgroup analysis, however, showed superior survival rates in cemented fixation in studies including patients of all ages as compared to those studies that only studied younger (≤ 55 years old) patients. Year of publication was associated with improved survival of uncemented implants relative to cemented implants (i.e. uncemented fixation showed relative superiority with time) [21].

Up to the authors' knowledge, there is no similar prospective study that compares the early results of cementless versus hybrid THA in treatment of PTOA.

The purpose of this study was to evaluate the early results of cementless versus hybrid THA performed to treat PTOA of hip joint.

The study included 22 cases who were subdivided into two groups each included 11 cases. The first group performed cementless THA, the second one underwent hybrid THA. Age and sex distribution did not differ significantly between the study groups ($p > 0.05$).

In our study, mean operative time in the cementless group was 100.7 ± 10.3 minutes and it was significantly shorter than the hybrid group ($p = 0.001$). Other perioperative circumstances including perioperative complication rate (18.2%), blood transfusion requirements (2.2 ± 0.9 RBCs units) and length of hospital stay (8.7 ± 2.7 days) were higher in hybrid group but statistically insignificant.

PROMs are meant to complement traditional outcome measures such as local complications, general adverse events and re-operations or revisions. It is generally accepted that pain relief and improved function are the principal aims of joint replacement. However, clinician-based tests are biased and not considered appropriate for the description of the patients' perception of their state of health. Despite many limitations, such as their bounded nature and difficulty with interpretation, PROMs represent the best objective measurement of the information being sought [22].

There are many programmes collecting and monitoring Patient-Reported Outcome Measures (PROMs) for arthroplasty surgery e.g. OHS, HHS, the Hip Disability and Osteoarthritis Outcome Score, the Lequesne Index of Severity for Osteoarthritis of the Hip, WOMAC index, etc. [23,24].

In our study, we used WOMAC, OHS and HHS to evaluate the results of THA and to assess clinical

and functional outcomes. PROMs showed early better improvement in the hybrid THA group till the end of the first year. At the end of follow-up, the average WOMAC, OHS and HHS were 6.82 ± 5.9 , 44.45 ± 4.13 and 90.66 ± 10.77 respectively in cementless THA group which were higher than the Hybrid group but statistically insignificant.

Conclusion:

Although, THA is one of the most successful and cost-effective treatment options of PTOA, no single type of THA is superior to the others in all circumstances.

References

- 1- DIRSCHL D.R., et al.: Articular fractures. JAAOS-Journal of the American Academy of Orthopaedic Surgeons, 12 (6): p. 416-23, 2004.
- 2- THAMBYAH A.J.M.H.: A hypothesis matrix for studying biomechanical factors associated with the initiation and progression of Posttraumatic Osteoarthritis, 64 (6): p. 1157-61, 2005.
- 3- KRAMER W.C., K.J. HENDRICKS and J. WANG: Pathogenetic mechanisms of posttraumatic osteoarthritis: Opportunities for early intervention. International Journal of Clinical and Experimental Medicine, 4 (4): p. 285, 2011.
- 4- KELLAM P. and R.F. OSTRUM: Systematic review and meta-analysis of avascular necrosis and posttraumatic arthritis after traumatic hip dislocation. Journal of Orthopaedic Trauma, 30 (1): p. 10-16, 2016.
- 5- TANNAST M., NAJIBI S. and MATTA J.M.: Two to twenty-year survivorship of the hip in 810 patients with operatively treated acetabular fractures. JBJS, 94 (17): p. 1559-67, 2012.
- 6- ZHANG L., et al.: Total hip arthroplasty for failed treatment of acetabular fractures: A 5-year follow-up study. The Journal of Arthroplasty, 26 (8): p. 1189-93, 2011.
- 7- BANASZKIEWICZ P.A.: Improved Cementing Techniques and Femoral Component Loosening in Young Patients with Hip Arthroplasty: A 12-Year Radiographic Review, in Classic Papers in Orthopaedics, Springer, p. 31-4, 2014.
- 8- CHENG S.L., et al.: The effect of the medial collar in total hip arthroplasty with porous-coated components inserted without cement. An in vivo canine study. The Journal of bone and joint surgery. American, Volume 77 (1): p. 118-23, 1995.
- 9- BELLAMY N., et al.: Validation study of WOMAC: A health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. The Journal of Rheumatology, 15 (12): p. 1833-40, 1988.
- 10- BELLAMY N.: Outcome measurement in osteoarthritis clinical trials. The Journal of Rheumatology, Supplement 43: p. 49-51, 1995.
- 11- DAWSON J., et al.: Questionnaire on the perceptions of patients about total hip replacement. The Journal of bone and joint surgery. British volume, 78 (2): p. 185-90, 1996.
- 12- MURRAY D., et al.: The use of the Oxford hip and Knee Scores, 89 (8): p. 1010-4, 2007.
- 13- BANASZKIEWICZ P.A.: Traumatic arthritis of the hip after dislocation and acetabular fractures: Treatment by mold arthroplasty: An end-result study using a new method of result evaluation, in Classic Papers in Orthopaedics., Springer, p. 13-7, 2017.
- 14- BROWN T.D., et al.: Posttraumatic osteoarthritis: A first estimate of incidence, prevalence, and burden of disease. Journal of Orthopaedic Trauma, 20 (10): p. 739-44, 2006.
- 15- PUI C.M., et al.: Increased complication rate following conversion total hip arthroplasty after cephalomedullary fixation for intertrochanteric hip fractures: A multi-center study. The Journal of Arthroplasty, 28 (8): p. 45-7, 2013.
- 16- HAIDUKEWYCH G.J. and D.J. BERRY: Salvage of failed internal fixation of intertrochanteric hip fractures. Clinical Orthopaedics and Related Research®, 412: p. 184-8, 2003.
- 17- KRAUSE P.C., J.L. BRAUD, and J.M. WHATLEY: Total hip arthroplasty after previous fracture surgery. Orthopedic Clinics, 46 (2): p. 193-213, 2015.
- 18- KNIGHT S.R., R. AUJLA, and S.P. BISWAS: Total Hip Arthroplasty-over 100 years of operative history. Orthopedic reviews, 3 (2), 2011.
- 19- FRYMAN J.C.: Patient-specific instruments for total hip arthroplasty, Google Patents, 2012.
- 20- GOYAL D., M. BANSAL and R. LAMORIA: Comparative study of functional outcome of cemented and uncemented total hip replacement. Journal of Orthopedics, Traumatology and Rehabilitation, 10 (1): p. 23, 2018.
- 21- MORSHED S., et al.: Comparison of cemented and uncemented fixation in total hip replacement: A meta-analysis. Acta. Orthopaedica, 78 (3): p. 315-26, 2007.
- 22- ROLFSON O. and H. MALCHAU: The use of patient-reported outcomes after routine arthroplasty: Beyond the whys and ifs, 2015.
- 23- FRANKLIN P.D., J.J. ALLISON, and D.C. AYERS: Beyond joint implant registries: A patient-centered research consortium for comparative effectiveness in total joint replacement. Jama, 308 (12): p. 1217-8, 2012.
- 24- ROLFSON O., et al.: Patient-reported outcomes in the Swedish Hip Arthroplasty Register: Results of a nationwide prospective observational study. The Journal of bone and joint surgery. British, Volume 93 (7): p. 867-75, 2011.

مقارنة النتائج المبكرة للإستبدال الكامل لمفصل الفخذ الأسمنتي والهجين في مرضى الخشونة ما بعد الكسور

إن المرضى الذين يصابون بالخشونة ما بعد الصدمة في مفصل الفخذ لهم خيارات الجراحية محدودة، إلا أن الإستبدال الكامل لمفصل الفخذ علاج فعال ويمكنه تحسين وظيفة مفصل الفخذ لدى هؤلاء المرضى رغم الصعوبات المنوطة به وإرتفاع نسبة المضاعفات.

منذ نشأة عمليات إستبدال المفصل الكامل لمفصل الفخذ، وأنواعه في تطور مستمر لتحسين أدائها إلا أنه لم تثبت الكفاءة التامة لأحد هذه الأنواع عن الأخرى في جميع الحالات.

الهدف من الدراسة: سوف تقوم هذه الدراسة بمقارنة النتائج المبكرة لمفصل الفخذ الكامل للأسمنتي والهجين في مرضى الخشونة ما بعد الكسور.

المرضى: إشمطت الدراسة على ٢٢ حالة (١١ حالة لكل مجموعة). وشملت المجموعة (أ) المرضى الذين أجرى لهم الإستبدال بمفصل لأسمنتي، والمجموعة (ب) شملت الحالات التي أجرى لها الإستبدال بمفصل هجين.

النتائج: لم يكن هناك فروق ذات دلالة إحصائية بين المجموعتين فيما يتعلق بالمتغيرات الديموغرافية ($p>0.05$). كان وقت الجراحة أعلى بكثير في المجموعة الثانية ($p>0.001$). لم يكن هناك إختلاف بين المجموعتين في نسبة المضاعفات، معدلات نقل الدم أو مدة الإقامة داخل المستشفى. لم يرد إختلافاً ذو دلالة إحصائية بين المجموعتين فيما يتعلق بمقاييس هاريس، أوكسفورد أو وماك.

الإستنتاج: في الختام، تحدد الدراسة الحالية أن تركيب مفصل الفخذ الصناعي الكامل بعد كسور الفخذ أو الحوض من أفضل الحلول المتاحة لهؤلاء المرضى، مع عدم الأفضلية التامة لأحد الأنواع على الآخر.