



International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2021; 7(4): 474-476
© 2021 IJOS
www.orthopaper.com
Received: 07-08-2021
Accepted: 09-09-2021

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Osseointegration in uncemented total hip arthroplasty: A study of 37 cases

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DOI: <https://doi.org/10.22271/ortho.2021.v7.i4g.2919>

Abstract

Introduction: Osseointegration is the ability of implants to establish mechanical and functional bond with bone without forming any connective tissue. Osseointegration is useful for clinical follow-up in many implants e.g. dental implants, hearing aids, spinal fusion implants, prosthesis. Endoprosthesis functions pain free when their anchoring components are firmly fixed to the osseous tissue. Total hip arthroplasty is a common procedure in many conditions that reduces pain and improves functions. Non-cemented implants need precise preparation of implant bed and additional fixation device such as screws or projections that cut into the bone to achieve stability. The long term stability and function of joint replacement can be evaluated on the basis of outcomes. If improper osseointegration occurs then fibrinous tissue formed between bone and implant that cause weak and loose implant.

Materials and Methods: This was an observational type of study where non-cemented total hip replacement done by different surgeons were included for follow-up. The follow-ups were done in US Bangla Medical College Hospital, Narayanganj and Kurmitola General Hospital, Dhaka between July 2017 to December 2019. A total of 37 patients of total hip replacement were included in this study strictly following inclusion and exclusion criteria.

Results and Discussion: To see the functional outcome Harris Hip Score (HHS) was done. Mean HHS at their final follow-up was 88.32 ± 10.32 . There were 19 (51.44) patients in excellent category, 11 (29.7%) in good, 4 (10.8%) fair and 3 (8.1%) in poor category according to HHS. Engh's score was used to see the radiological outcome and it is divided into two part Fixation and Stability. Mean fixation Engh's score was 5.27 ± 4.63 and stability score was 9.46 ± 8.78 . Mean of total Engh's score was 14.73 ± 12.67 . Out of 37 patients 25 (67.6%) patients were bone ingrown, 7 (18.9%) in-growth suspected, 3 (8.1%) suboptimal but stable and 2 (5.4%) were unstable according to Engh's score for radiological evaluation.

Conclusion: To see the osseointegration accurately CT scan or other precise imaging technique should be used. However radiographic evaluation of uncemented total hip arthroplasty by x-ray is valuable method to see osseointegration. But it needs long term follow-up.

Keywords: non-cemented total hip replacement, osseointegration, harris hip score, Engh's score

Introduction

Surgical implants made of metal or ceramics were applied for centuries to replace dead tissue [1]. However there is limited success in achieving bony integration with implants [2]. Osseointegration is the ability of implants to establish mechanical and functional bond with bone without forming any connective tissue [3]. The understanding of osseointegration has evolved with the help of new radiological investigations to assess the surface between bone and implant [4]. Currently in osseointegration the bone around implant should counteract compressive, bending and tensile loads [5] and present within 50 micrometer from implant to avoid fibrous tissue formation [6].

Osseointegration is useful for clinical follow-up in many implants e.g. dental implants, hearing aids, spinal fusion implants, prosthesis [7-13]. For achieving direct skeletal fixation there are many factors such as properties of implant surface, quality of bone, preparation of surgical site, postoperative loading, design of implant and infection prevention [4].

Endoprosthesis functions pain free when their anchoring components are firmly fixed to the osseous tissue [14].

So implant fixation is very important for outcome of joint replacement. Non-cemented implants need precise preparation of implant bed and additional fixation device such as screws or projections that cut into the bone to achieve stability [15]. The long term stability and function of joint replacement can be evaluated on the basis of outcomes.

Total hip arthroplasty is a routine operation in many conditions that reduces pain and improves functions [16]. Many inflammatory factors released from hematological cells interact at implant surface and starts an immune response. This ultimately led to osseous tissue formation over the prosthesis [17]. Matrix made of fibrinous tissue is first initiated which acts as a frame for osteoblasts [17]. After completion of osseointegration the implant interface is entirely filled with osseous tissue [17]. If improper osseointegration occurs then fibrinous tissue formed between bone and implant that cause weak and loose implant [17]. Outcomes of non-cemented prosthesis after a decade are acceptable (85%) which became 70% acceptable 5 years later [18]. Most of the implant failed due to aseptic loosening [19].

To assess osseointegration of implants both clinical and radiological assessment was done preoperatively and at final follow-up. Clinical outcome was done by Harris Hip Score and radiological outcome by Engh score [20].

Materials and Methods

This was an observational type of study where non-cemented total hip replacement done by different surgeons were included for follow-up. The follow-ups were done in US Bangla Medical College Hospital, Narayangonj and Kurmitola General Hospital, Dhaka between July 2017 to December 2019. A total of 37 patients of total hip replacement were included in this study strictly following inclusion and exclusion criteria.

Inclusion criteria

- Non-cemented total hip replacement
- Two year postoperative follow-up

Exclusion criteria

- Cemented total hip arthroplasty
- Revision surgery

Ethics

After the approval of ethical committee all the patients were given a questionnaire to fill-up. They were briefed about the follow-up technique by clinical and radiological outcome. After that they had to fill-up a written informed consent.

Study design

Clinical outcomes were measured by Harris Hip score (HHS). It has total 100 points and considered excellent when score between 91 & 100, good between 81 & 90, fair between 71 & 80 and poor less than 71 [21, 22]. Radiological evaluation was done by Engh Gradin Scale score [23]. The scale has two parts; Fixation part ranging from -7.5 to 10 and Stability part ranging from -23.5 to 27. The implant was then classified into four groups "unstable" (below -10), "suboptimum but stable" (between -10 to <0), "in-growth suspected" (between 0 to 10) and "bone ingrown" (above 10). Other data such age, sex and follow-up duration were also recorded.

Results and Discussion

A total 37 patients of non-cemented hip arthroplasty were followed-up to see the osseointegration. Mean age of the

patients at their final follow-up was 44.5 ± 7.5 years ranging from 29 to 60 years. About 65% [24] patients were male and 35% [13] patients were female. Mean follow-up duration was 3.5 ± 1.07 years where minimum follow-up was 2 years and maximum 5.6 years.

Table 1: Harris Hip Score and Engh's Score

	Mean	SD
Harris Hip Score	88.32	10.32
Engh's Score		
Fixation	5.27	4.63
Stability	9.46	8.78
Total	14.73	12.67

To see the functional outcome Harris Hip Score (HHS) was done. Mean HHS at their final follow-up was 88.32 ± 10.32 . There were 19 (51.44) patients in excellent category, 11 (29.7%) in good, 4 (10.8%) fair and 3 (8.1%) in poor category according to HHS.

Table 2: Harris Hip Score at Final Follow-up

	Patient	Percentage
Excellent	19	51.4
Fair	4	10.8
Good	11	29.7
Poor	3	8.1

Engh's score was used to see the radiological outcome and it is divided into two part Fixation and Stability. Mean fixation Engh's score was 5.27 ± 4.63 and stability score was 9.46 ± 8.78 . Mean of total Engh's score was 14.73 ± 12.67 . Out of 37 patients 25 (67.6%) patients were bone ingrown, 7 (18.9%) in-growth suspected, 3 (8.1%) suboptimal but stable and 2 (5.4%) were unstable according to Engh's score for radiological evaluation.

Table 3: Engh's Score at final follow-up

	Patient	Percentage
Bone ingrown	25	67.6
In-growth suspected	7	18.9
Suboptimal but stable	3	8.1
Unstable	2	5.4

Our study was comparable to other study on osseointegration. Epinette, *et al.* (2017) showed HHS 92.3 ± 7.4 , 99.03 ± 4.19 and 98.06 ± 4.49 for 3 different stems used in total hip replacement. Engh's score were 21.88 ± 5.17 , 21.67 ± 5.44 and 17.83 ± 4.85 for 3 different stems.

In another study Moore, *et al.* (2006) reported, out of 119 patients 106 (89%) patients had bone ingrown and rest 11% were fibrous, stable or loose during revision surgery. Moore, *et al.*, (2006) showed osseointegration of 98 acetabular cups and 95 (97%) of them had bone ingrown at revision surgery. Twelve patients had no radiological sign, but 10 (83%) of them were found unstable during revision surgery.

Conclusion

To see the osseointegration accurately CT scan or other precise imaging technique should be used. To confirm the osseointegration autopsy is essential which is very difficult to arrange. However radiographic evaluation of uncemented total hip arthroplasty by x-ray is valuable method to see osseointegration. But it needs long term follow-up.

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