

## Original Research Article

# Hip arthroplasty - study correlating intra operative stable range of motion with postoperative functional activity

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## ABSTRACT

**Background:** Squatting and sitting cross-legged is a part of lifestyle both for employment and for daily ablutions. When these activities can be allowed after hip arthroplasty is not documented. The aim of this study is to identify if patients having good intra-operative stability with the posterior approach, can start high flexion activities early.

**Methods:** In this retrospective study, all hip arthroplasty patients done from 2013-2017 were considered for inclusion. Patients were evaluated for intra-operative stable range of motion and patients who were stable were encouraged to do cross-legged sitting from 2 weeks after surgery and squatting from 6 weeks after surgery. The follow-up visits were at 6-weeks, 3-months and 1-year after surgery. Parameters assessed were Harris hip score, short form survey-12 (SF-12) score, limb length discrepancy, range of motion and ability to sit cross-legged and squat. All the patients were again called for a follow-up visit and the parameters were reassessed.

**Results:** Sixty patients were included in the study. Mean follow-up was 2 years 3 months. Mean Harris hip score and SF-12 showed improvement from 64.8 and 19.5 at 3 months to 88.3 and 37.8 respectively at last follow-up. At the end of 3 months, 85% patients could sit cross-legged and 50% could squat. At one year, the corresponding figures were 85% and 70%.

**Conclusions:** If intra-operative range of motion testing is satisfactory, early initiation of high flexion hip activities is safe.

**Keywords:** Squatting post-total hip replacement, Cross-legged sitting post- total hip replacement, Intra-operative ROM testing total hip replacement, High-flexion post- total hip replacement

## INTRODUCTION

In India, the number of patients requiring hip arthroplasty (HA) is expected to rise phenomenally in the future.<sup>1,2</sup> The challenges of the future will include provision of increased beds in hospitals for HA patients.<sup>3</sup> Early discharge is one way to achieve the same. Our country has a large rural population below poverty line with minimal access to rapid transportation in case of a post-operative complication after discharge. Many of these patients are

operated under free government schemes. The current norm in most of the hospitals having similar patient profile as ours is to make the patient stay in the hospital for at least 5 days from surgery or till suture removal (2 weeks from the surgery). This entails increased research to find out which patients can be safely discharged early from public hospitals.

In urban areas, changing lifestyles with decreased physical activity and decreased exposure to sunlight with rampant

vitamin D deficiency is leading to early osteoporosis which in addition to increased life expectancy is leading to hip fractures in patients who are wage earners and are employed.<sup>4-6</sup> Many of these patients end up requiring HA and expect high flexion activities after surgery. Rural employment opportunities are dependent on sitting cross-legged, squatting and frequent sitting on the floor.<sup>7</sup> In addition, in rural areas, the need for using commode entails squatting early after surgery. Changing social culture is leading to abandonment of joint families in favour of nuclear families, where no one is present to look after the elderly persons.<sup>8,9</sup> This is placing increased demand for greater and early recovery of high flexion activities on the operated hips.

There are no guidelines on when squatting can be started after HA with a posterior approach. The majority of surgeon's in India do a total hip replacement from the posterior approach and most start with squatting 1 year from the surgery in cases of hemiarthroplasty and may not allow the same in cases of total hip arthroplasty (THA).<sup>10-12</sup> Waiting for 1 year from surgery is problematic for these patients as western commodes are not available in most rural areas. The aims of our study were to find: the time period from surgery when squatting and cross-legged sitting can be allowed after HA, and if patients can be discharged safely 48 hours after surgery in our set up.

## METHODS

This is a retrospective study, which was conducted in the Department of Orthopaedics, (D. Y. Patil Medical College, Nerul, Navi Mumbai). Ethics committee approval was taken for the study. In this study, all HA patients operated by two senior surgeons (initials) of a single unit from March 2013 to June 2017 were evaluated for inclusion in the study. The 1<sup>st</sup> senior surgeon (TS) either did the surgery or was present as assistant surgeon in all cases done by 2<sup>nd</sup> senior surgeon (AR).

A unit in our institution handles all kinds of orthopaedic cases and is not an only arthroplasty unit. Most of our patients are from rural background and sitting cross-legged on the floor and squatting was a demand of these patients. Many of these patients were doing these activities at the follow up visit without our permission as using the Indian commode was a necessity. Looking at this we decided to test stability of the hip intra-operatively and to achieve extra stability for these activities (described later in article), as we knew that the patient is going to do these activities despite our advice to the contrary. Good results with this extra stability led us to do the same for all of our patients.

### Inclusion criteria

Age 40-75 years and had undergone HA. The long-term effect of these high flexion activities on survival of implant is not known and that is the reason why these activities were restricted in patients below 40 years of age.

Patient had to be alive at the time of study.

The follow-up record should be complete till 1-year post-surgery.

Unilateral HA.

Preoperative body mass index (BMI) <40 kg/m<sup>2</sup>.

No perioperative cardiopulmonary complication.

Satisfied intra-operative stability goals as described later in the article.

### Exclusion criteria

Revision arthroplasty.

Pathological fractures proximal femur.

Any complex primary HA.

A total of 118 HA were done during the study period. 38 patients were excluded; 13 patients did not meet the inclusion criteria, 11 patient's data was incomplete and 14 patients were either of revision or complex primary arthroplasty. Of the remaining 80, who met the inclusion and exclusion criteria, 9 patients died during the follow-up period and 11 patients did not consent for inclusion in the study (as they were living in far off rural places and were not willing to come) or were untraceable. The remaining 60 patients were called for a follow-up visit. Pre-operative diagnosis was fracture neck femur in 32 patients, failed intertrochanteric fracture fixation in 11 patients, avascular necrosis of head of femur in 16 patients and osteoarthritis secondary to acetabular fracture in 1.

We had explained the patients pre-operatively, that squatting and sitting cross-legged may or may not be possible post-operatively and no specific guarantee regarding the same was given. Also dislocation and limb length discrepancy were specifically mentioned as complications of this procedure in the written consent. All patients had a primary HA performed by the posterior approach under combined spinal and epidural anaesthesia. In all fracture patients, integrity of acetabular articular cartilage decided whether a bipolar hemiarthroplasty (BHA) or a THA was done. The acetabular component was inserted first followed by the femoral component in THA. Intraoperatively, Shuck test and combined anteversion test of Ranawat were done for all patients. Stability testing intra-operatively was done with hip in the following positions - flexion of 90 degrees with 20-degree adduction and 25 degrees of internal rotation, flexion of 110 degrees with 10-degree adduction and 10 degrees of internal rotation, maximal possible flexion (110-130 degrees) in neutral adduction-abduction, abduction of 30 degrees in maximum possible flexion, in as much external rotation as possible to 10 degrees internal rotation, and maximum external rotation possible in full hip extension.

For testing stability, the hips were first flexed/extended which was followed by movement of adduction/abduction and finally by external/internal rotation to reach the required position of stability testing. We tried to get the limb length equal to the opposite side but if the hip was unstable then we did not hesitate to lengthen the limb up to 1 cm if stability was better in that position, as high offset stem was not available because of economic issues. Posterior capsular repair was done in all patients. Postoperative drains were used in all patients. Intravenous (IV) traxenamic acid 10 mg/kg body weight was given pre-operatively to all patients. Aspirin (75 mg) twice in a day was given for 6 weeks starting from postoperative day 2.

Patients were asked to use hip abduction bar overnight during sleep till 2 weeks from surgery. In the recovery room, once the patient was out of anaesthesia, they were started with log rolling, static quadriceps, ankle pump exercises and toe movements. On postoperative day 1, Foley's catheter and drains were removed, and walking with walker (full weight bearing) was started. On day 2, IV line was removed and dressing was changed. The physiotherapist then managed patients although the primary responsibility of the patient rested with the orthopaedic surgeon. Two weeks after surgery, they were encouraged to walk independently without assistive devices. Cross-legged sitting was allowed after 2 weeks of surgery but within the limits of pain (first in bed then on floor). At 6 weeks from surgery, patients were encouraged to squat.

The data on demographics (age, sex, BMI and comorbidities), diagnosis of the patient, date of injury/fracture, date of surgery, kind of HA (bipolar/THA; cemented/uncemented) and clinical examination findings of same side knee, opposite side hip and spine (along with x-rays) were extracted from the hospital records. Harris hip score, Western Ontario and McMaster universities arthritis index (WOMAC) score, SF-12 and visual analog scale (VAS) score for pain at discharge were noted.

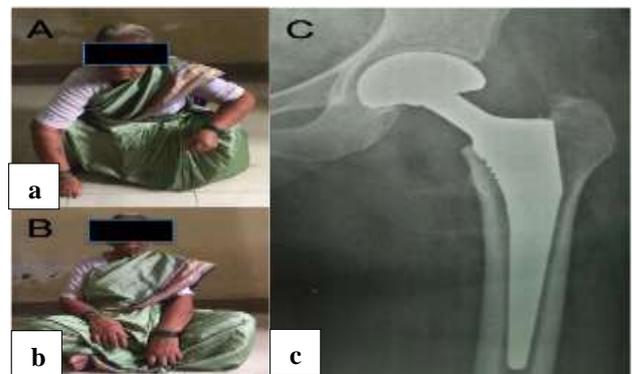
The data of follow up at 6-week, 3-month and 1-year post surgery was extricated from follow up records. This included duration of time from surgery when patient started squatting and sitting cross legged, Harris hip score, WOMAC score, and SF-12 scores. Data on VAS score for pain at 2 weeks, 6 weeks and 3 months from surgery was available. All of these parameters and range of motion were measured at the latest follow-up visit at the hospital outpatient department.

## RESULTS

Of 118 patients operated for HA during the study period, 60 were enrolled for the study. Cemented BHA was done in 24 patients, uncemented BHA in 9, uncemented cylindrical long stem BHA in 2 and uncemented THA in 25 patients. The average age of our patients was 57 years (range 40-75 years). In 40-60 years age group, 5 patients underwent BHA and 10 underwent THR. In patients aged

above 60 years of age, 30 patients underwent BHA and 15 patients underwent THR. The femoral head size was 32 mm in all THR patients. 32 patients were females and 28 were male. Mean duration of follow up was 2 years 3 months (range-1 year 4 months to 4 years). Degenerative changes were seen in the spine/opposite hip/same side knee in 45 out of 60 patients; 12 patients had same side knee involvement, 14 patients had opposite hip involvement and 36 patients had spine involvement as judged clinically and by radiology.

Management by the physiotherapist started 48 hours after surgery in 49 (83%) patients, on day 5 in 9 patients and on day 14 in 2 patients. Two patients had an undisplaced femoral periprosthetic fracture. Both of these fractures happened at the tip of cylindrical long stem femoral prosthesis and did not require any operative intervention except non-weight bearing for 6 weeks. One patient had superficial infection, which was treated with antibiotics. There was no dislocation, deep infection or deep venous thrombosis in the study patients. One patient had limb lengthening of 1.2 cm on the operated side. One patient (1.6%) had wound gaping on postoperative day 8 and required secondary suturing. The mean Harris hip score improved from 64.8 at 3 months to 88.3 at last follow-up. Mean WOMAC score improved from 18.1 at 3 months to 6.8 at last follow-up. Mean SF-12 showed improvement from 19.5 at 3 months to 37.8 at last follow-up. The mean VAS score for pain improved from 7 at 2 weeks after surgery to 2 at 3 months after surgery. Mean range of motion at latest follow-up is as given in Table 1. At the end of 3 months, 85% patients could sit cross-legged and 50% could squat (Table 2 and Figure 1 and 2). At one year, there was no increase in the number of patients who could sit cross-legged but the number of patients who could squat increased from 50% to 70%. There was no change in the ability to sit cross-legged or squat at the latest follow-up as compared to the 1-year follow-up. One-third of the patients who could squat had pain due to associated degenerated spine/same side knee or opposite hip. 28 out of 32 fracture neck femur patients were able to squat while only 3 of the 11 intertrochanteric fracture patients were able to squat.



**Figure 1: Bipolar hemiarthroplasty patient at 12 weeks after surgery (a) squatting, (b) sitting cross-legged, and (c) anteroposterior hip x-ray.**

**Table 1: Studies reporting on percentage of patients doing squatting/cross-legged sitting.**

S. No.	Author/year	F/u duration (years)	No. of HA (patients)	Mean (range)			% patients doing squatting	% patients doing cross-legged sitting
				Flexion	Abduction	External rotation		
1	Anil K Rai 2008 <sup>13</sup>	4	55	-	-	-	85.45	85.45
2	Hidenobu 2007 <sup>14</sup>	1	30	87 (35-110)	29 (10-40)	31 (10-40)	100	100
3	Hao Tang 2014 <sup>15</sup>	2-10	818	-	-	-	70	-
4	Our study 2018	1	60	115	-15* to 30	-20 to 35 <sup>#</sup>	85	70

\*negative value represents adduction, #negative value represents mean internal rotation

**Table 2: Time of starting of high flexion activity.**

Assessment point	Sitting crossed leg number		Squatting number	
	Bipolar (35/60)	THA (25/60)	Bipolar (35/60)	THA (25/60)
At 2 weeks	2	0	0	0
6 weeks	15	9	0	0
3 months	30	20	20	10
1 year	30	21	25	17

**Table 3: Range of motion of hip required for high flexion activity.**

Author/year	Study population	Flexion Mean±SD		Abduction Mean±SD		Internal rotation* Mean±SD	
		Squatting	Sitting crossed leg	Squatting	Sitting crossed leg	Squatting	Sitting crossed leg
Hemmerich 2006 <sup>16</sup>	Indian	95.4±26.6	83.5±35.7	26.1±11.6	34.1±14.7	-16.5±10.5	-37.1±17.7
Yamamura 2007 <sup>17</sup>	Japanese	110.8	106.7	2.2	41.8	9.6	-25.3
Mulholland and Wyss 2001 <sup>18</sup>	Asian	>130	90-100	10-30	40-45	-5 to -36	-35 to -60
Sugano 2012 <sup>19</sup>	Japanese	80±16	-	+8.6±9.5	-	-9.2±11	-

\*negative values indicate internal rotation



**Figure 2: Total hip arthroplasty patient at 12 weeks from surgery (a) pre-operative x-ray showing osteoarthritis of right hip following acetabular fracture with implant in situ (b) post-operative x-ray (c) squatting and (d) sitting cross-legged.**

## DISCUSSION

We had set out to find an answer to the following questions - to identify if patients having good intra-operative stability can be started early (within 6 weeks) on high flexion hip activities and will the operated hip be stable enough to perform activities required for rural employment; and to identify if patients can be discharged early (on postoperative day 2).

For high flexion activities, we require impingement-free range of motion with stability for each high flexion activity. Studies in the past measuring the range of motion required for squatting and cross-legged sitting, have expressed their results, as mean with range (Table 3) of movements in the three planes. Patients with values in the higher range during intra-operative testing in a single movement ex flexion, may not require a higher range in other movement, ex adduction or internal rotation, for performing a high flexion activity. Considering this we

decided on the range of movement to be tested intra-operatively for hip stability. One additional point we would like to raise is that stability tested during surgery will increase with the healing of soft tissues over a period of time. In this study we have avoided going into the factors affecting stability e.g. anteversion of hip and femur radiologically and offset measurement. If intra-operatively the hip is not stable then the surgeon needs to verify the parameters affecting stability and correct them. If the hip is not stable enough after correcting all parameters, then high flexion activities should be restricted either permanently or till the soft tissues heal.

In our study, there are both BHA and THA patients, which introduces bias in favour of BHA patients as they have a bigger head with lesser chances of dislocation; but our study is not about the comparison of THA with BHA for high hip flexion activities. The study is about establishing a specific stable impingement free range of motion to allow safe high hip flexion activities whether you achieve that with BHA or with THA.

The requirement of high flexion activities is mainly in the Asian countries (Japan, Korea and India). We have documented the studies reporting on squatting and cross-legged sitting after THA in Table 3. The only study we could find on squatting and sitting cross-legged was by Rai et al who had designed a bipolar prosthesis and he showed that 85% of his patients could squat and sit cross-legged.<sup>13</sup> He did not mention that after how many days of the surgery did, he allow his patients to squat. Hidenobu et al in their study had shown that 100% of their patients could sit cross-legged and squat at 1 year after surgery.<sup>14</sup> Although most of his surgeries were done for dysplastic hips, his patients were young with an average age of 49 years. He did not report any dislocation in his series. The training for squatting started in our study at 6 weeks and progressed as per patient's ability to do the same voluntarily. In our patients, although the acetabulum was not dysplastic, the average age was 57 years. Degenerative changes in the spine, opposite hip and same side knee were present in 45 of the 60 patients and although many of these patients with degenerative changes were able to squat with support, they had pain (in the degenerated areas) and it was being done out of necessity of using the commode. We had no incidence of dislocation in spite of encouraging the patients to start these activities early suggesting that the intra-operative range of testing done by us allows for safe early initiation of these activities.

Studies in the west are currently being done to find out the feasibility of same day or within 24 hours of surgery discharge.<sup>20-24</sup> The trend in public hospitals in is to discharge the patients on day 5 if the patient can be rapidly transported to a hospital in emergency or on day 14 if the patient is from far flung rural areas. The post-operative support staffs in public hospitals in are either non-existent or are not trained to answer patient queries telephonically and it is not possible for the operating surgeons to answer most of the queries if the patient is discharged in 24 hours

after surgery. So, the manpower infrastructure is not tuned for early discharge (within 24 hours). Overall 48 out of 49 patients, who were managed by the physiotherapist from day 2, did not require any further orthopaedic intervention or re-admission till 1 year after surgery. These patients could have been discharged home on day 2 if a physiotherapist would have visited them at home. Dorr and Klein had earlier published studies on outpatient HA with a mini-posterior approach.<sup>20,22</sup> In Dorr's study, 23% patients could not be discharged on the same day of surgery suggesting that discharge within 12 hours of surgery is too early with the posterior approach. In Klein's study all the patients were discharged on the same day of surgery but 10/559 patients had hematoma formation requiring evacuation. This did not happen in our study because of the usage of tranexamic acid to decrease bleeding, usage of aspirin for deep vein thrombosis (DVT prophylaxis) and the use of post-operative drains.

### **Limitations**

The follow-up records were available at assessment points of follow up and we do not know the exact time in weeks when the patients started squatting.

It was a retrospective study. Our records were well maintained with regards to high flexion activities as that is the primary concern of a majority of patients and our staff is geared to look into this specifically.

There is heterogeneity of indications in our study. The range of motion and stability (pre and post-operatively) in patients with these diagnoses is different and all have been clubbed together as a group. Our study is not about the comparison of results with different diagnosis but what we want to say is that whatever be your indication of surgery, if you have done this intra-operative testing and if the patient has the post-operative range of motion to do high hip flexion activities, it will be safe to carry on with these activities.

Intra-operative assessment of stable range of motion was done by visual estimation and no goniometer was used for the same. This introduces the chances of intra-observer and inter-observer bias regarding the same but this makes it convenient and fast.

### **CONCLUSION**

Early initiation of high flexion hip activities if intra-operative range of motion testing is satisfactory is safe and should be done for faster recovery. Discharge two days after HA surgery in selected patients with home visitation by physiotherapist is safe.

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