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## Original Article

# Functional and radiographic evaluation and quality of life analysis after cementless total hip arthroplasty with ceramic bearings: minimum of 5 years follow-up<sup>☆,☆☆</sup>

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## ABSTRACT

**Objective:** The aim of the study is to analyze and correlate functional and radiographic results and quality of life in patients undergoing cementless total hip arthroplasty with ceramic surface, performed at Hospital Servidor Publico de Sao Paulo from 2001 to 2006.

**Methods:** We retrospectively analyzed 35 hips treated with cementless total hip arthroplasty with ceramic surfaces with a minimum follow-up of 5 years. Functional evaluation was based on the Harris Hip Score (HHS). Radiographic evaluation was based on the method proposed by Charles Engh for evaluation of femoral osseointegration and on DeLee and Charnley zones for acetabulum. Quality of life was assessed by SF-36 questionnaire.

**Results:** The HHS presented excellent and good results in 91% of patients postoperatively (mean of 93.14 points HHS). As for radiographic evaluation, we found excellent results in 100% of evaluated hips (proven osseointegration). SF-36 scores were not compared to the control group for the following components: pain, vitality, mental health and social aspects. The difference between HHS pre and postoperatively had a statistically significant correlation with physical functioning of the SF-36.

**Conclusion:** Total hip arthroplasty with ceramic surface is a treatment that enables functional improvement of the hip and increases quality of life of patients to levels close to those of people without joint diseases.

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## Avaliação funcional, radiográfica e da qualidade de vida após artroplastia total de quadril não cimentada com superfície cerâmica-cerâmica: seguimento mínimo de cinco anos de evolução

### R E S U M O

**Palavras-chave:**  
Artroplastia  
Quadril  
Cerâmica  
Óxido de alumínio

**Objetivo:** Analisar e correlacionar os resultados funcionais e radiográficos e o grau de qualidade de vida em pacientes submetidos a artroplastia total de quadril não cimentada com superfície em cerâmica feita no Hospital Servidor Público Estadual de 2001 a 2006.

**Métodos:** Fizemos um estudo retrospectivo que analisou 35 quadris tratados com artroplastia total do quadril não cimentada com superfície em cerâmica, com tempo de seguimento mínimo de cinco anos. A avaliação funcional baseou-se no questionário de Harris Hip Score (HHS), a avaliação radiográfica baseou-se no método proposto por Charles Engh para o fêmur e sinais de integração óssea nas zonas de DeLee e Charnley para o acetábulo e a avaliação da qualidade de vida baseou-se no questionário SF-36 (*Medical Outcomes 36 Item Short-Form Health Survey*).

**Resultados:** O questionário HHS apresentou resultados considerados como excelentes e bons em 91% dos pacientes no pós-operatório (média de 93,14 pontos HHS). Quanto à avaliação radiográfica, em 100% dos quadris operados tivemos osteointegração óssea comprovada. Os escores do SF-36 não foram estatisticamente significantes em relação ao grupo controle para os seguintes componentes: dor, vitalidade, aspectos sociais e saúde mental. A variação entre o HHS pré e pós-operatório se correlaciona com a capacidade funcional no SF-36.

**Conclusão:** A artroplastia total com superfície de cerâmica é uma operação que possibilita a melhoria funcional do quadril e o aumento da qualidade de vida do paciente para níveis próximos aos da população sem doenças da articulação.

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## Introduction

The modern era of total hip arthroplasty began around 1958, with Sir John Charnley. This is an excellent treatment method for pain relief and functional improvement among patients with degenerative hip disease.<sup>1</sup>

The unresolved challenge in hip arthroplasty is to develop contact surfaces that are able to withstand the higher demands of younger and more active patients.<sup>2</sup> Ceramics started to be used as prostheses in the 1970s by Boutin apud Lusty et al.<sup>3</sup> Better results have also been achieved through improvements in the ceramic manufacturing process.<sup>4</sup>

The ceramic surfaces currently in use are made of alumina and/or zircon (Fig. 1). They are extremely hard and scratch-resistant, and they provide better lubrication and resistance to wear, in comparison with other surfaces.<sup>5</sup>



Fig. 1 – Ceramic surfaces made of alumina and zircon.

The aim of the present study was to analyze the quality of life and functional and radiographic results from cementless hip arthroplasty with ceramic surfaces.

## Materials and methods

A retrospective study was conducted at Hospital Servidor Público Estadual de São Paulo, in which patients were clinically and radiographically evaluated between 2000 and 2006. In all cases, the patients signed a free and informed consent form.

The investigation was conducted on all the patients with joint degeneration who were treated surgically by means of cementless hip arthroplasty with ceramic surfaces. In this sample, ethnicity, sex and social condition were not taken into consideration.

Forty hips were selected. Five cases were subsequently excluded: three that were lost from the follow-up and two that did not attend assessments. In the present study, 25 patients were evaluated (35 hips), comprising 13 men and 12 women of mean age 52 years (range: 36–66) and with mean length of postoperative follow-up of six years and four months.

All the patients were evaluated before and after the operation by means of the HHS questionnaire, radiographically according to the biological fixation of the acetabular and femoral components and by means of the SF-36 questionnaire, adapted for the Portuguese language.

The HHS questionnaire, which was described in 1969 (*Annex 1*), ranges from 0 to 100 points, with the classifications excellent, good, moderate and insufficient (*Table 1*).<sup>6</sup>

**Table 1 – Classification of Harris Hip Score questionnaire.<sup>6</sup>**

Harris Hip Score	Points
Excellent	90–100
Good	80–89
Moderate	70–79
Insufficient	<70

With regard to radiographic analysis, given that bone growth is the main stabilizer for cementless prostheses, we evaluated the biological fixation in accordance with the method proposed by Charles Engh (as shown in Table 2) for the femoral component, which classifies the fixation as confirmed bone growth (more than 6 points), probable bone growth (from 0 to 6 points), stable fibrous encapsulation (0 to 10 points) and, lastly, unstable (less than 10 points).<sup>7</sup> For the acetabular components, the criterion for good bone integration that we used was the absence or progression of a radiolucent line >2 mm in the De Lee and Charnley zones, absence of movement or migration of the component, absence of screw breakage and absence of metal particles.<sup>8</sup> To evaluate the migration of the components, a comparative assessment of radiographs produced with at least a one-year interval between them was necessary.

To analyze quality of life, we used the SF-36. This is formed by 36 items that encompass eight components: functional capacity, physical aspects, pain, general state of health, vitality, social aspects, emotional aspects and mental health. It presents a final score from 0 to 100, in which zero corresponds to the worst general state and 100 to the best state of health.<sup>9</sup>

The results from the SF-36 questionnaire among the patients under evaluation were compared with the results from a control group with characteristics similar to those of our sample. The control group was established from among healthy patients seen at the internal medicine outpatient clinic, and was composed of 20 patients (10 men and 10 women) of mean age 50 years.

The results obtained were expressed as means and minimum and maximum values (quantitative variables) or by absolute frequencies and percentages (qualitative variables).

To compare the HHS from before to after the operation, the Wilcoxon test was used. Spearman's correlation was used to investigate whether there was any relationship between the SF-36 and the HHS. The significance level used was 5%.

## Results

Before the operation, the mean score was found to be 46 points (insufficient), as shown in Table 3. In the final evaluation, the mean score was 93 points (excellent). Results considered to be excellent or good were presented by 91.4% of the patients (Table 4).

According to the radiographic assessment method for confirming bone growth proposed by Engh, all of our patients presented proven bone growth (mean of 17 points) (Table 5). For the acetabulum, we did not find any signs of migration or movement of the components. Likewise, there were no breakages of screws, no radiolucent lines that were progressive or greater than 2 mm, and no metal particles.

In no case was there any squeaking, loosening, sign of wear, osteolysis, debris or breakage of ceramic (either at the time of implanting the component or later on).

The means for the eight components of the SF-36 are expressed in Table 6.

A comparison of the results between male and female patients is shown in Table 7.

Correlation between the postoperative HHS and SF-36 did not show statistical significance for any component of the SF-36. However, there was a significant relationship between the change in the HHS from before to after the operation and the patients' functional capacity. There was no relationship between the preoperative HHS and the SF-36.

## Discussion

The results from arthroplasty are traditionally expressed as rates of morbidity-mortality, postoperative complications and prosthesis wear. However, with the improvement of implants and surgical techniques, these measurements are losing their relevance and may not reflect the real benefits for patients.

**Table 2 – Engh score.<sup>7</sup>**

Engh score			
Direct signs	Demarcation line around the porous surface >60% (Annex 1 Harris Hip Score questionnaire <sup>6</sup> ; 5 points)	Demarcation line <60% (0 points)	Absence of demarcation line (+5 points)
Indirect signs	Hypertrophy of calcar (Annex 1 Harris Hip Score questionnaire <sup>6</sup> ; 4 points)	Indeterminate (0 points)	Atrophy of calcar (+4 points)
	Unstable smooth surface (Annex 1 Harris Hip Score questionnaire <sup>6</sup> ; 3.5 points)	Indeterminate (0 points)	Stable smooth surface (+5 points)
	Unstable pedestal (Annex 1 Harris Hip Score questionnaire <sup>6</sup> ; 3.6 points)	Stable pedestal (0 points)	No pedestal (+2.5 points)
Stability score	Migration (Annex 1 Harris Hip Score questionnaire <sup>6</sup> ; 5 points)	Indeterminate (0 points)	No migration (+3 points)
	Demarcation lines (Annex 1 Harris Hip Score questionnaire <sup>6</sup> ; 2.5 points)	Indeterminate (0 points)	Interface with alterations (+2.5 points)
	Detachment of metal particles (Annex 1 Harris Hip Score questionnaire <sup>6</sup> ; 6 points)	Indeterminate (0 points)	No detachment (+1 point)

**Table 3 – Significant functional improvement after the operation, in relation to before the operation ( $p < 0.05$ ), according to the Harris score.**

Radiographic score	Minimum value	Maximum value	Mean	p value
Before operation (points)	21	65	46	<0.05
After operation (points)	76	100	93	

**Table 4 – Absolute frequencies and percentages of results from Harris Hip Score questionnaire.**

Harris Hip Score	Absolute frequency	Relative frequency
Excellent	24	68.6%
Good	8	22.8%
Moderate	3	8.6%
Insufficient	0	0%
Total	35	100%

**Table 5 – Quantitative results from radiographic score.**

Radiographic score	Minimum value	Maximum value	Mean
Points	8	24	17

There is now increasing interest among researchers in transforming the concepts of quality of life and joint function into a quantitative measurement that could be used in clinical trials for comparisons between populations and different diseases.<sup>9-11</sup> In our study, we observed a significant improvement in function, in comparing the HHS from before the operation (46 points) to after the operation (93 points).

Our results were consistent with the study published by Lusty et al.,<sup>3</sup> who evaluated 222 arthroplasty procedures with a minimum follow-up of five years and mean score of 97 points.

Yoo et al.<sup>8</sup> evaluated 93 hips with a mean score of 97 points according to the HHS (mean length of follow-up of five years).

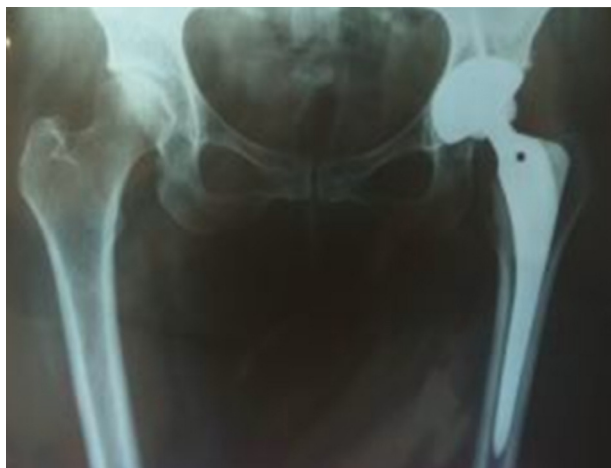
Hamadouche et al.<sup>4</sup> evaluated 45 patients who underwent the Boutin operation, with a mean follow-up of 19.8 years, and found that 75% of the cases had excellent or good results.

**Table 6 – SF-36 scores of the patients and control group.**

SF-36	Groups	Mean	p value
Functional capacity	Control	89.29	0.0007
	Case	60.8	
Limitation due to physical aspects	Control	92.86	0.0175
	Case	48	
Pain	Control	80.29	0.1754
	Case	62.76	
General state of health	Control	76.14	0.0071
	Case	50.08	
Vitality	Control	75.71	0.1611
	Case	62.4	
Social aspects	Control	91.07	0.3702
	Case	79.5	
Limitation due to emotional aspect	Control	100	0.023
	Case	54.67	
Mental health	Control	85.14	0.0921
	Case	71.04	

**Table 7 – SF-36 scores of the male and female patients.**

SF-36	Sex	Mean	p value
Functional capacity	Female	56.67	0.4059
	Male	64.62	
Limitation due to physical aspects	Female	39.58	0.5382
	Male	55.77	
Pain	Female	64.25	0.8517
	Male	61.38	
General state of health	Female	45.42	0.4371
	Male	54.38	
Vitality	Female	59.58	0.6495
	Male	65	
Social aspects	Female	76.04	0.3702
	Male	82.69	
Limitation due to emotional aspect	Female	61.11	0.4696
	Male	48.72	
Mental health	Female	68	0.4696
	Male	73.85	



**Fig. 2 – Radiograph of total hip arthroplasty with ceramic surfaces, showing confirmed bone integration.**

Among our patients, 91.4% had results that were considered excellent or good, although our mean length of follow-up was six years and four months.

All the hips evaluated presented confirmed bone growth for the femoral and acetabular components (Fig. 2), which was also in line with the literature. Yoo et al. evaluated 93 hips with a minimum follow-up of five years and observed that all the hips evaluated presented confirmed bone growth for both components of the prosthesis.<sup>8</sup>

Regarding quality of life, several studies have shown higher scores for physical health, such as in relation to pain and functional capacity, after hip arthroplasty. The largest and fastest increase occurred in relation to pain scores, and greatest progress was seen over the first six months. When the improvement in quality of life is low, comorbidities should be taken into consideration.<sup>10-12</sup>

Wilklund and Romanus<sup>13</sup> demonstrated that patients who underwent total hip arthroplasty presented a quality-of-life index value similar to that of a control group with the same age and sex distribution.

In the present study, the SF-36 scores were not statistically significant in relation to the control group for the components of pain, vitality, social aspects and mental health.

Nilsdotter and Lohmander<sup>14</sup> did not find any differences in SF-36 scores between men and women after the operation. In the same study, when the patients were separated into two groups (older and younger than 72 years), it was observed that the quality-of-life scores showed similar improvements, except in relation to physical capacity. The authors proposed that the multiple comorbidities of more elderly patients might explain this.

Lieberman et al.<sup>15</sup> attempted to establish a relationship between the HHS and the SF-36. They found a strong correlation between the HHS and physical health components among men of all ages and among women over the age of 65 years. There was a poor correlation with the mental health component, particularly among women younger than 65 years. In comparison with the score for the normal population subdivided according to gender and age, men under the age of 65

years had lower physical health scores. Among women of all ages, the physical components were lower than in the normal population of the same age and sex, and the most evident difference was among women under the age of 65 years.

In the present study, there were no significant differences between the genders. The age range of the patients evaluated was narrow and they were considered to be relatively young for total hip arthroplasty.

The relatively young age of the patients evaluated in this study, together with the high demands and expectations of these individuals, explains the difference in some components of the SF-36 that was found in relation to the normal population, despite the great functional improvement shown by the HHS.

## Conclusion

We conducted a functional, radiographic and quality-of-life evaluation on patients with ceramic implants. Through these implants, we hoped to attend to younger and older patients with higher demands, and to achieve greater survival of the implant. Our study allows the inference that arthroplasty with ceramic surfaces is a surgical procedure that enables functional improvement of the hip and provides increased quality of life for patients, attaining levels close to those of the population without joint diseases.

The limitations of this study that should be taken into consideration are that this was a retrospective study and that assessments on the patients were only done once after the operation.

The initial results have encouraged us to continue with this method, albeit with the proviso that further studies will be needed in relation to this material, with a longer follow-up.

## Conflicts of interest

The authors declare no conflicts of interest.

## Appendix A.

Harris Hip Score instrument

I. Pain (44 possible)

A) None or unknown 44

B) Slight, occasional, without compromising activities 40

C) Mild, does not affect practice of ordinary activities; rarely, moderate pain after practicing unusual activities; can use simple analgesic 30

E) Severe, activities greatly limited 10

F) Totally incapacitated, crippled, pain in bed, bedridden 0

## Appendix (Continued)

## II. Function (47 possible)

## A) Gait (way of walking) (33 possible)

## 1. Claudication (limping)

a) None 11

b) Mild 8

c) Moderate 5

d) Severe 0

## 2. Support

a) None 11

b) Stick for long walks 7

c) Stick for most of the time 5

d) One crutch 3

e) Two sticks 2

f) Two crutches 0

g) Unable to walk 0

(specify the reason: -----)

## 3. Distance capable of walking

a) Unlimited 11

b) Six blocks 8

c) 2-3 blocks 5

d) Only inside the home 2

e) Bed and chair 0

## B) Activities (14 possible)

## 1. Going up and down stairs

a) Usually without holding on to bannister 4

b) Usually holding on to bannister 2

c) In some manner 1

d) Unable to go up or down stairs 0

## Appendix (Continued)

## 2. Putting on shows and socks

a) Easily 4

b) With difficulty 2

c) Unable to do it 0

## 3. Sitting

a) Sitting comfortably on an ordinary chair for one hour 5

b) Sitting on a high chair for half an hour 3

c) Unable to sit comfortably on any chair 0

## 4. Taking public transport 1

## III. The patient is considered not to have points of deformity (4) when the following are presented:

A) Contracture in flexion remains less than 30°

B) Contracture in fixed adduction is less than 10°

C) Contracture in fixed internal rotation in extension is less than 10°

D) Discrepancy in leg lengths less than 3.2 centimeters

## IV. Range of motion (the value for the index is calculated by multiplying the degrees of movement possible in each range by the respective index)

## A. Flexion

0-45° × 1.0

45-90° × 0.6

90-100° × 0.3

## B. Abduction

0-15° × 0.8

15-20° × 0.3

More than 20° × 0

## Appendix (Continued)

## C. External rotation in extension

0-15 × 0.4

More than 15° × 0

## D. Internal rotation in extension

Any × 0

## E. Adduction

0-15° × 0.2

To determine the general score for range of motion, multiply the general score for range of motion and multiply the sum of the index values by 0.05. Register the Trendelenburg test as positive, leveled or neutral.

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