



ARAŞTIRMA / RESEARCH

Evaluation of acetabular erosion after hemiarthroplasty

Hemiartroplasti sonrası asetabular erozyonun değerlendirilmesi

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Abstract

Purpose: The primary aim of this study is tomographic evaluation of acetabular erosion after hemiarthroplasty and analyse the related risk factors.

Materials and Methods: Between January 2012 and December 2013 A total of 89 patients, who were treated with hemiarthroplasty for femoral neck fracture, 48 patients included to this study. Computerized tomography (CT) images were analyzed to evaluate the acetabular erosion. The CT images were scanned with Autocad program. Associations between the amount of erosion identified, sex and age of patients, body mass index (BMI), type of prosthesis, and Harris hip scores were analyzed.

Results: There was no significant difference in acetabular erosion with regard to the type of the prosthesis used. Quantity of acetabular erosion was similar between different type of prosthesis; however, erosion was significantly high in patients with high BMI.

Conclusion: This study showed that BMI is the only determining factor found to relate to acetabular erosion. CT is a useful imaging modality in evaluating acetabular erosion after hemiarthroplasty.

Key words: Acetabular erosion, Hemiarthroplasty, Computerize tomography

Öz

Amaç: Bu çalışmanın amacı hemiarthroplasti sonrası oluşan asetabular erozyonun bilgisayarlı tomografi (BT) ile değerlendirilmesi ve ilişkili risk faktörlerinin tanımlanması.

Gereç ve Yöntem: Ocak 2012 ile Aralık 2013 arasında Femur boyun kırığı nedeniyle hemiarthroplasti uygulanan toplam 89 hastadan düzenli takibi yapılabilen 48 hasta bu çalışmaya dahil edildi. Asetabular erozyonu değerlendirmek için bilgisayarlı tomografi (BT) kesitleri incelendi. BT görüntüleri Autocad programı ile tarandı. Erozyon miktarı ile hastaların yaşı, cinsiyeti, vücut kitle indeksleri (VKİ) ve protez tipleri arasındaki ilişki araştırıldı ve Harris kalça skorları hesaplandı.

Bulgular: Kullanılan protez tipine göre asetabular erozyonda anlamlı bir fark saptanmadı. Asetabular erozyon miktarı farklı protez tiplerinde benzer saptandı. Bununla beraber yüksek vücut kitle indeksine sahip hastalarda erozyon anlamlı olarak daha fazla saptandı.

Sonuç: Bu çalışma, VKİ'nin asetabular erozyonla ilişkili belirleyici faktör olduğunu göstermiştir. BT hemiarthroplasti sonrası asetabular erozyonun değerlendirilmesi için kullanışlı bir görüntüleme metodudur.

Anahtar kelimeler: Hemiartroplasti, asetabular erozyon, bilgisayarlı tomografi

INTRODUCTION

Hemiarthroplasty is generally the treatment of choice for most hip fractures in elderly population^{1,2}. Compared to a total hip replacement, hemiarthroplasty procedures involve shorter surgical times and lower prosthesis costs. Hemiarthroplasty

success, however, is often limited due to resulting pain from extensive cartilage erosion and loss of joint space. Acetabular erosion is one of the serious complication of the hemiarthroplasty of the hip. Controversial issues include: whether to use unipolar or bipolar modular head to prevent this complication; and whether total hip prosthesis

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would be a better solution in elderly patients with osteoporosis³. Several studies have reported various clinical outcomes and risk factors in the development of acetabular erosion after hemiarthroplasty²⁻⁴. Routine orthopedic practice patients who underwent partial hemiarthroplasty are followed up with direct radiography in the outpatient clinic⁵. However, there is no evidence that acetabulum erosions can be detected by direct radiography, especially in the early postoperative period. Acetabular erosion can be detected earlier with computerized tomography (CT).

This study aims to evaluate the quantity of acetabular erosion with regard of BMI, age, type of prosthesis, and Harris hip score (HHS). The relationship between acetabular erosions formed in different types of prosthesis on pelvic solid model obtained from finite element method were compared with the clinical findings.

MATERIALS AND METHODS

This study conducted by as retrospectively in Adana Numune Research and Educational hospital and İzmir Atatürk Research and Educational hospital. Between January 2012 and December 2013, a total of 89 patients, who were treated with hemiarthroplasty for femoral neck fracture, 48 patients were included in this study. It was learned that 14 patients died in the follow up period and 27 patients could not be reached. Patient demographics are shown in Table 1.

Table 1. Patients characteristics

| | |
|-------------------------|-----------------|
| Age (yr) Mean | 78.63 (66-89) |
| Gender(n) | |
| Male | 12 |
| Female | 36 |
| Body mass index (Mean) | 26.70(21-33) |
| Harris hip score (Mean) | 7 0.45 (22-100) |
| Type of Prosthesis (n) | |
| Bipolar | 19 |
| Straight | 16 |
| Calcar | 13 |

The inclusion criteria were the ability to live independently (without reliance on a caregiver), a nonpathological fracture, and a hip with no or minimal osteoarthritic changes. The exclusion criteria included medical or physical comorbidities that limited independent living, any history of disorders known to severely affect bone and mineral metabolism, a preexisting hip abnormality requiring

total hip arthroplasty or a pathological fracture secondary to malignant disease. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All of the procedures were performed by experienced three surgeons using a standardized transgluteal lateral approach. Height and weight measurements were performed during the follow-up visit.

The patients were personally interviewed and examined. Many of the patients involved were either unable to attend the department or unfortunately died during the course of the study. Therefore at the final follow up only 48 patients - 36 female and 12 male (female/male ratio: 3.0) - contributed. The mean follow-up period was 28 months (minimum: 26, maximum 34 months).

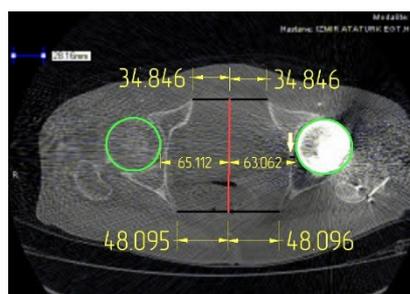


Figure 1. Axial CT image of pelvis in a 85 year old female patient who underwent hemiarthroplasty secondary to left collum femoris fracture. The patient presented with a six-month history of left hip pain at 30 month follow up. Acetabular erosion is demonstrated in the left hip with yellow arrow.

Evaluation of Acetabular Erosion

CT (Aquilion 64,Toshiba, Japan) was performed by the help of the same technician in supine position. From the image cross sections obtained, the deepest points of the acetabulum were observed. Thereafter right and left distal prominences of both anterior columns (acetabular fossa) were used as landmarks. Then these reference points were used to draw a straight anterior line. The same methodology was used to draw a posterior reference line. The vertical intersection line connecting the midpoints of two reference lines is accepted as the midpoint of the pelvis. Finally the distance from the modular head of the prosthesis and healthy femoral head to the

mid- point of pelvis were measured using Autocad program as shown in Figure 1. The relationship between the quantity of erosion, BMI, age, sex, type of prosthesis, and HHS were statistically analyzed⁵. Harris hip score consists of 4 subtitles as pain, function, range of motion, and absence of deformity. Maximum score is 100. According to this scoring system; increasing scores correlate with good results, contrarily decreasing scores correlate with poor results.

Statistical analysis

SPSS (Statistical Package for Social Sciences) 17.0 for Windows (Chicago, IL, USA) was used for statistical analysis. All data was summarized in tables during the analysis of the study data. Descriptive statistical methods (mean, standard deviation, and percent) in addition to Mann Whitney test, Kruskal Wallis, and correlation statistics were used. Results were accepted as significant in 95% confidence interval, $p < 0.05$.

RESULTS

Quantity of acetabular erosion was analyzed with regard to sex. Mean amount of erosion was calculated as 0.23 ± 0.08 mm/year for men, and 0.17 ± 0.08 mm/year for women. There was more erosion in men than in women, however, this was not statistically significant (p value: 0.137).

There was no significant difference in acetabular erosion with regard to the type of the prosthesis used. Mean erosion in calcar support prosthesis, straight stem partial prosthesis, and bipolar prosthesis were calculated as 0.17 ± 0.08 mm/year, 0.22 ± 0.09 mm/year, and 0.12 ± 0.05 mm/year respectively. The least amount of erosion was recorded in the bipolar prosthesis group, with the highest seen in straight stem partial prosthesis. However, no statistically significant differences were found between these 3 different prosthetic designs as shown in Table 2.

Table 2. Relationship between sex, type of prosthesis and quantity of erosion

| | Quantity of erosion (mean \pm SD) |
|--------------------|-------------------------------------|
| Sex | |
| Male | 0.23 \pm 0.08 |
| Female | 0.17 \pm 0.08 |
| Type of Prosthesis | |
| Calcar (n=13) | 0.17 \pm 0.08 |
| Bipolar (n=19) | 0.12 \pm 0.05 |
| Straight (n=16) | 0.22 \pm 0.09 |

Between Calcar and Bipolar p : 0.296, Between Calcar and Straight p : 0.268, Between Bipolar and Straight p : 0.194

Analysis of age and Harris Hip Scores did not show any increased risk of acetabular erosion. However, BMI and the amount of erosion in relation to direct proportion was noted (p : 0.018; r : 0.601). At the end of the clinical and radiological evaluation total hip arthroplasty surgery was performed for three of our patients. These patients had resulting hip pain complaints: one with the diagnosis of femoral stem loosening, and two with acetabular protrusion. Hip function according to the HHS was similar at follow-ups.

DISCUSSION

Acetabular erosion appears to be an important complication of partial endoprosthesis. The response of acetabular cartilage to load against metal prosthesis has been studied frequently and it

was shown that repetitive stress could result with degeneration and erosion⁶⁻⁸.

Defining the position of acetabular margins is complicated and surgeons may be unable to detect migration of the prosthetic head until the acetabular erosion is advanced. This problem can lead to intra and interobserver variabilities in the evaluation of erosion^{9,10}. The author believes that more accuracy can be obtained with CT. CT scan evaluation is gaining popularity in the assessment of the bone after joint arthroplasty¹¹. To the best of the author's knowledge this is the first study evaluating acetabular erosion with CT after hemiarthroplasty.

Minihane et al. reported severe degeneration at the 6th month in the acetabular joint cartilage but no difference in trabecular bone in a study on dogs⁶. Furthermore, in an experimental study of dogs,

Crues emphasized that proteoglycan loss was present 2-4 weeks after endoprosthesis placement in the acetabulum. Thereafter surface damage in the cartilage tissue and progressive degeneration occur, and finally pannus structure forms⁷. Kempson attributed the elasticity loss in the joint cartilage to the decreased quantity of glucosamine⁸.

In the present study the highest amount of erosion was detected in patients with straight stem unipolar prosthesis (0.22 mm per year); this was found lesser in calcar support unipolar prosthesis as 0.17 mm/year. The amount measured in bipolar partial prosthesis which was 0.12 mm/year was lower than the other prosthesis types; however, no statistical significance was obtained due to the low number of patients. In a study by Moon et al in 2008, annual erosion in bipolar partial prosthesis was measured on X-rays and found to be 0.23 mm/year¹². In a study Ayhan et al suggested that although the bipolar head movement was preserved in inactive patients, they suppose that this conferred no advantage to these patients, who could hardly walk¹³. Furthermore Calder et al recommend that a unipolar prosthesis may give better short-term results in octogenarians¹⁴.

Patient's age and sex were not associated with an increased risk of erosion in the present study. This is well documented in current literature. Trubea et al evaluated the risk factors for acetabular erosion in patients after hemiarthroplasty⁴. The authors reported no correlation between sex, size of the prosthesis, bone mineral density and acetabular erosion⁴.

Literature is conflicting regarding the increased risk of acetabular erosion in more active patients. Philips found that the amount of erosion increased as the activity level of the patient increased¹⁵. However, Moon et al reported that the patients with higher Harris hip scores had lesser acetabular erosion after hemiarthroplasty¹². No significant relation was observed between Harris hip score and the quantity of erosion in the present study.

A key finding of the present study is that BMI is the only determining factor found to relate to acetabular erosion. McGibbon et al presented similar results¹⁵. The authors revealed that the amount of erosion was found to be greater in cases of increased acetabular contact pressure in patients with partial endoprosthesis. Therefore high BMI increases the pressure on acetabulum, and thus the quantity of

erosion increases. The author suggests that bipolar or total hip arthroplasty should be the treatment of choice for hip fractures in patients with high BMI.

The author acknowledges some limitations of the present study. Firstly, the number of patients contributing decreased during the course of the study due to circumstances out with our control. Studies with greater a patient sample would be better placed to draw conclusions as to the effects of age, bone quality and type of prosthesis on the annual acetabular erosion.

Secondly, in this study, only horizontal displacement of prosthesis heads in CT cross sections could be calculated. However, observing the hip joint in three dimensions, it is evident that the erosion is not only in the horizontal plane, but displacement is present also in all 3 planes. Rosenbaum demonstrated in his study that there are 3 main orientations for the migration of prosthesis head: proximal & medial; proximal & lateral; & pure proximal¹⁶. In addition, the migration was associated with the position of the head, CE angle, and the position of femoral stem in the medullar channel. Advanced well designed studies are needed in the evaluation of acetabular erosion in light of these studies

We can conclude that acetabular erosion seems an inevitable result of hemiarthroplasty after two years but the clinical picture is variable. Although radiological erosion was determined, we observed that most of the patients are pain free and active. With the advent of new technologies which prevent metal artifacts, CT is a useful imaging modality in evaluating acetabular erosion after hemiarthroplasty. It offers an alternative imaging tool where erosion cannot be detected in serial follow-up radiographs.

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