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Failure after core decompression in osteonecrosis of the femoral head

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Abstract In a retrospective study of 39 hips with osteonecrosis of the femoral head treated with core decompression we evaluated the extent of the necrotic area, the Ficat stage and the location of the lesion. The extent of the necrotic lesion was classified into three categories: mild, less than 15%; moderate, 15–30%; and severe, more than 30%. In 14 mild cases core decompression failed in 2, whereas there were 4 failures out of 7 moderate cases and 16 failures out of 19 severe cases. The extent and location of the necrotic portion as well as the Ficat stage can be used as predictors for the result of core decompression in osteonecrosis of the femoral head.

Résumé Dans une étude rétrospective de 39 hanches avec osteonécrose de la tête fémorale traitée avec décompression nous avons évalué l'ampleur de la région de la nécrose, les Ficat stage et l'emplacement de la lésion. L'ampleur de la lésion de la nécrose a été classée dans trois catégories: doux, plus petit que 15%; modéré, 15–30%; et sévère, plus que 30%. Dans 14 décompressions du cœur des cas doux manqués en 2 alors qu'il y avait 4 échecs hors de 7 cas du modéré et 16 échecs hors de 19 cas sévères. L'ampleur et emplacement de la portion de la nécrose aussi bien que l'étape Ficat peut être utilisée comme prophètes pour le résultat de décompression du cœur dans osteonécrose de la tête fémorale.

Introduction

Core decompression of the femoral head has been performed since 1971 in order to try to preserve the head and its articular surface. However, the clinical results have been very variable [1, 4, 5, 6, 8, 11, 15, 17]. We analysed 39 hips which underwent core decompression in order to determine the correlation between successful results and prognostic factors.

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Materials and methods

We performed core decompression on 39 hips in 31 patients. All the patients were men, their average age was 47 years (range: 29–69 years) and they were followed for an average of 61 months (range: 24–118 months). The causes of the osteonecrosis were alcoholism in 20, steroid overdose in 10, and 9 were idiopathic.

The operation was performed through a lateral approach under fluoroscopic control. In 13 hips the operation was performed with 3–6 multiple cores using a 6.5-mm drill bit. In 26 hips it was done with a single core using a 1.0-cm-diameter trephine and of these 16 were grafted with corticocancellous bone.

For every patient the initial and the follow-up anteroposterior and lateral pelvis radiographs were reviewed and the clinical symptomatic changes and radiographic progression were assessed. Ficat staging was modified from the original Ficat classification. The location of the lesion was noted in the mid-coronal MRI and was classified into three categories: medial, central and lateral. A medial location was defined as a lesion which was located only in the medial one-third of the circumference of the femoral head. A central location was defined as a lesion in the central one-third of the head with or without medial one-third involvement, and a lateral location was defined as a lesion in the lateral one-third with or without involvement of the medial two-thirds. MRI was performed pre-operatively with a GE Signa Advantage 1.5T (GE Medical Systems, Americas, Milwaukee, Wis., USA), and the images were reconstructed by the two-dimensional Fourier transformation technique. The extent of osteonecrosis was estimated by using all of the relevant slices in the coronal and axial MRIs. In each slice the area of the abnormal signal intensity was regarded as a necrotic area (Fig. 1), and the area of the lesion was measured using the GE medical software (Fig. 1). The summation of all the necrotic areas was expressed as percentage of the total slice.

This measurement was made independently twice and the mean was used as the final data. The percentage of the area which was necrotic in each patient was classified into three categories: mild, 15% or below; moderate, 16–30%; severe, over 30% (Fig. 2).

The results of treatment were considered as either success or failure. If there was radiographic progression with further collapse, or progression in the Ficat stage, or if the hip was replaced, the result was considered a failure.

The success rate was correlated with the extent of the necrotic area, the Ficat stage and the location of the lesion. The Kaplan-Meier failure time plot was used to estimate the time from enrollment in the study to the last follow-up. The Cox proportional haz-

Table 1 Clinical results in relation to staging, location and grading of the osteonecrotic lesion

		Success	Failure	Spearman's correlation coefficient	*P*-value
Ficat stage	I	12	5	0.542	0.000
	II	5	9		
	III	0	8		
Location	Medial	4	3	0.375	0.009
	Center	7	2		
	Lateral	6	17		
MRI grading	Mild	12	2	0.673	0.000
	Moderate	3	4		
	Severe	3	16		

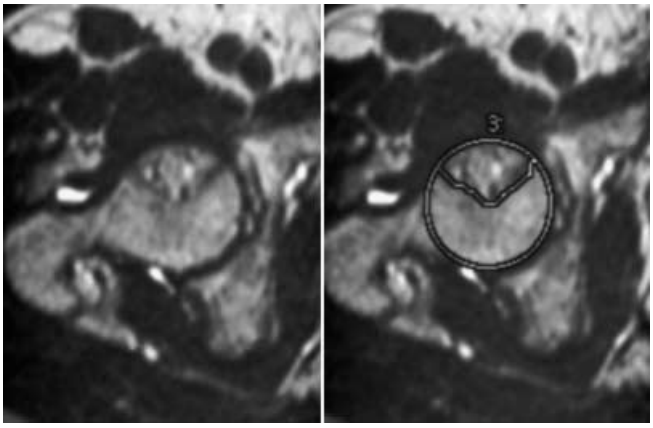

Fig. 1 Direct measurement of the necrotic area on MRI scan

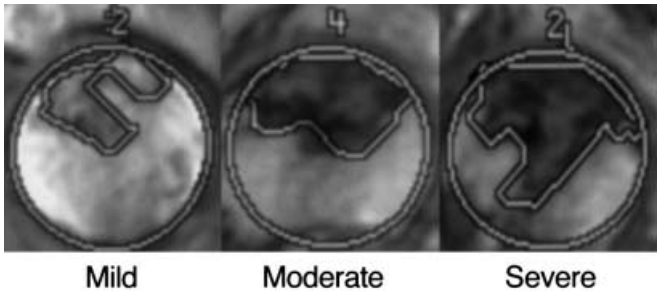

Fig. 2 The grade following the extent of lesion in MRI: mild, moderate, severe

ard model was used with 'time to failure' both as a dependent variable and as an independent variable. The Spearman rank correlation coefficient was calculated to assess the strength of the relationship among the three factors. All the hips were assumed to be independent in the statistical analysis which was done using Stata 3.1 (Stata Corporation 1993).

Results

Overall, out of 39 hips 17 were assessed as successful at a mean follow-up of 61 months. Nineteen arthroplasties were inserted because of unbearable pain or radiographic progression. In 14 hips the extent of the necrosis was classified as mild; in 7 hips as moderate, and as severe in 18 hips.

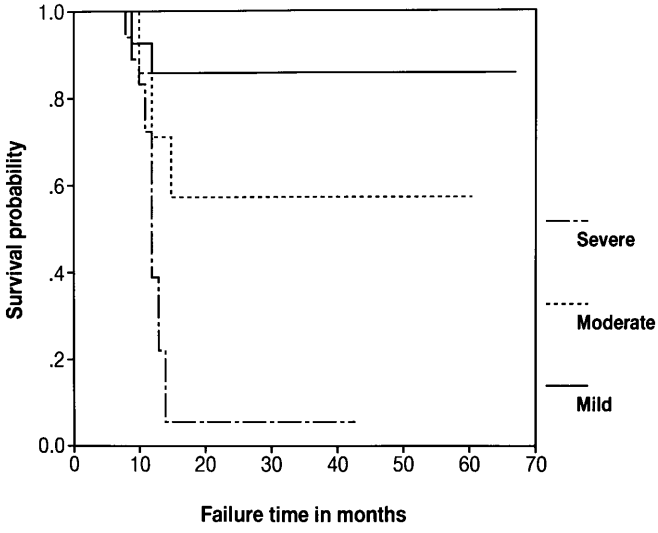

Fig. 3 Kaplan-Meier survival estimates for MRI grade

Kappa statistics was the method used for inter-observer reliability. Interpretation of the Kappa value was carried out as follows: less than 0.40 indicates poor reliability, 0.40–0.75 fair to good reliability, and 0.75–1.00 excellent reliability. In our study the calculated Kappa value was 0.747, thus the reliability of measurement was considered to be good. The extent of the necrotic area was found to be closely related to the success rate. There were 16 failures in 18 hips with severe necrosis, 4 failed hips out of 7 with moderate necrosis and 2 failures out of 14 hips with mild necrosis (Table 1).

The Ficat stage was also closely correlated with the failure rate. Five failures were observed in 17 hips with stage I. Nine failed out of 14 with stage II and 8 hips with stage III all failed (Table 1).

In a comparison of the location of the lesions the failure rates between medial and central lesions were not different. However, the failure rate was higher in hips with lateral lesions than in hips with medial or central lesions. Five out of 16 hips with medial or central lesions and 17 out of 23 hips with a lateral lesion were regarded as failures (Table 1).

Figure 3 shows the Kaplan-Meier failure time curves derived from these data. These showed significant sur-

vival time differences in the time to failure between the three groups (Log-rank chi-squared test, $P<0.05$).

Discussion

Core compression has been used for the treatment of osteonecrosis of the femoral head since first popularised by Ficat and Arlet, and by Hungerford and Lennox [7]. The clinical results are often very variable. The success rate ranges from 33% [9] to 92% [11]. Mont et al. [13] after reviewing 24 published articles reported an overall success rate of 63.5%. Therefore we have tried to assess the prognostic factors for core decompression.

Most authors agree that the extent of the necrotic area is closely related to the clinical outcome of osteonecrosis [8, 10, 13, 14, 16, 18]. However, different methods have been used for measurement of the extent of the lesion. Ohzono et al. [14] found that the extent of the osteonecrotic lesion in the weight-bearing portion of the femoral head was an important factor as assessed by plain radiographs but that MRI was more useful for early diagnosis [12]. Koo and Kim [8] tried to calculate the necrotic area by measuring the arc of the necrotic portion in the mid-coronal and mid-sagittal images. Takatori et al. [19] also measured the extent of the lesion in mid-axial and mid-coronal MRIs and found that the femoral heads in which the necrotic lesion occupied the major portion of the weight-bearing area had a considerable risk of collapse. Similarly Beltran et al. [2] measured the necrotic area in MRI and concluded that this estimation may help in predicting which femoral heads are likely to collapse after core decompression. In our study a more precise method was used. The disadvantage is that 12–14 images have to be examined in each hip. However, we believe that this is the most precise method currently available.

Mont et al. [13] from a study of the literature concluded that the results after core decompression in Ficat stage I were better than after stages II or III. In the present study the success rate in stage I was 70% and in stages II and III only 14%. Warner et al. [21] reported similar results. Ficat however reported more favourable results with a failure rate of only 33% in stages I and II. The results in stage III were less encouraging and this was reconfirmed in the present study [3, 20, 21]. We found a 14% success rate in stages I and II in our study, whereas all cases in stage III failed. Most reports agree that the clinical and radiological results are poor in stage III. We do not now perform core decompression in stage III and we do not recommend core decompression in stage II if the necrosis by MRI examination is revealed to be severe.

From our studies, we suggest the following clinical algorithm:

1. Patient with necrosis of the femoral head undergoes radiography, and if this reveals Ficat stages I or II MRI is indicated.
2. If MRI shows a necrotic segment of more than 30%, no core decompression is done. But if MRI shows a necrotic segment of less than 15%, a core decompression is recommended.

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