

THE INFLUENCE OF THE BIOMECHANICAL PARAMETERS OF THE HIP ON THE OUTCOME OF TREATMENT OF HIPS SUBJECT TO AVASCULAR NECROSIS OF THE FEMORAL HEAD

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Abstract: We were interested in whether or not the biomechanical status of the hip influences the course of avascular necrosis of the femoral head. To investigate this, we used a computer aided system based on a three dimensional mathematical model for determining the stress distribution in the hip joint from standard anteroposterior rentgenographs(X-ray images) of both hips and pelvis. Based on the results of our study, we suggest that the biomechanical parameters of the hip play an important role in the outcome of treatment of hips affected by avascular necrosis of the femoral head.

Key Words: Femoral Head, Avascular Necrosis, Biomechanics, Peak Hip Stress

INTRODUCTION

Avascular necrosis of the femoral head is characterized by variable areas of dead trabecular bone and bone marrow, extending to and including the subchondral plate [1]. It is a debilitating disease of younger adult patients that can lead to secondary arthrosis of the hip joint.

PATIENTS AND METODS

We studied how the biomechanical status of the involved hip influenced the clinical course of treatment for 50 hips in the long term (follow-up for 9 to 26 years). A computer aided system [2,3] based on a three dimensional mathematical model for determining the stress distribution in the hip joint was used. The peak stress on the weight bearing area, the position of the stress pole and the peak stress normalized for the body weight were determined from standard anteroposterior rentgenographs (X-ray images) of both hips and pelvis, and the results were compared with the clinical evaluation of the patients [4]. The patients were divided according to their treatment. The first group (20 hips) was treated by vascularized iliac crest grafting, while the second group (30 hips) was treated by various intertrochanteric osteotomies. Within both groups, we

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compared two subgroups: one with excellent or good results and the other with fair or poor results. In the intertrochanteric group of patients, we determined the biomechanical parameters pre and post operatively since the operation changed the hip joint morphometry. In the vascularised iliac crest grafting group, we determined the biomechanical parameters only pre operatively since the operation did not change hip joint morphometry.

RESULTS

We found no statistically significant differences in the peak hip stress between the two groups treated by the graft/osteotomy ($p=0.51$), nor between the subgroups within the two groups ($p_1=0.88$, $p_2=0.62$); the respective average values of the peak stress correspond to the values found in normal hips (average 2100 kPa).

The change in the peak stress due to operation in the intertrochanteric group of patients was found to be the most convincing(decisive) biomechanical factor influencing the final clinical outcome ($p=0.001$, Fig.1).

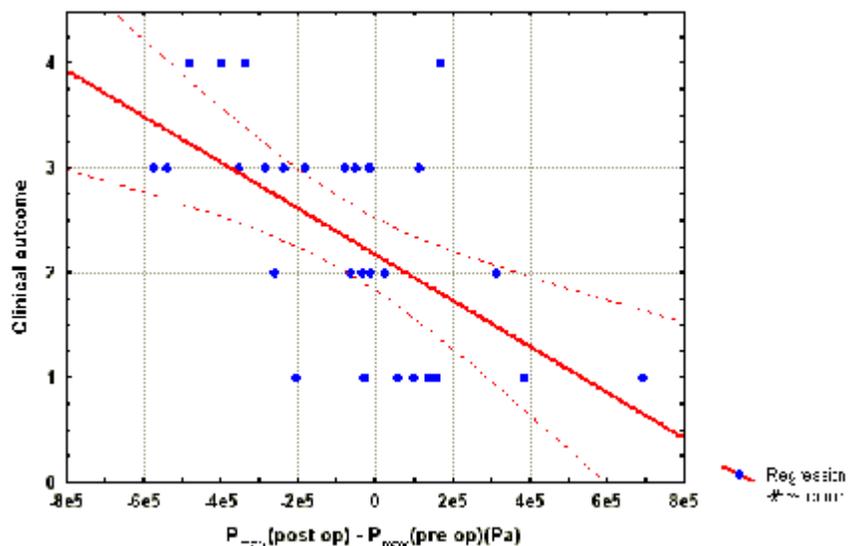


Fig 1. Clinical outcome as a function of Δp_{\max} ($\Delta p_{\max} = p_{\max \text{ post op}} - p_{\max \text{ pre op}}$). 4(excellent clin. outcome) \rightarrow 1(poor clin. outcome).

CONCLUSION

It was found that better clinical results can be expected when the operation significantly decreased the peak stress on the weight-bearing area.

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