HOW SHOULD DYSPLASTIC HUMAN HIPS BE EVALUATED?

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Abstract: Dysplasia of the human hip is characterised by insufficient anterolateral covering of femoral head by the acetabulum. In our study, we evaluated dysplastic human hip joints using biomechanical parameters (the peak contact stress in the weight-bearing area of the hip - p_{max}) and X-ray image parameters (the centre-edge angle - J_{CE}, the transverse acetabular inclination angle - J_{US}, the acetabular index of the weight-bearing zone - J_{AC}, the ACM angle - $J_{ACM,}$ and the hip value - HV). The purpose of this study is to make use of X-ray and biomechanical parameters to evaluate hips diagnosed with "hip dysplasia", and to establish whether or not there is a correlation between the two. Our results show a statistically significant correlation between p_{max} and J_{CE}, J_{US} and J_{AC}. The correlation between p_{max} and J_{ACM} and HV is not statistically significant.

Key Words: Hip Dysplasia, X-Ray Parameters, Biomechanical Parameters

INTRODUCTION

Residual hip dysplasia (RHD) is usually the result of developmental dysplasia of the hip. Arthrosis of the hip develops significantly less frequently in healthy hips than it does as a secondary condition to RHD. Increased hip joint pressure is responsible for this greater incidence of arthrosis accompanying RDH. Operational intervention is used to attempt to establish a more favourable distribution of stresses in the hip joint, and to slow down or prevent the development of hip arthrosis. X-ray evaluation is the established method for evaluating dysplasia of the hip, while biomechanical evaluation of the hip joint has more recently developed. We are primarily interested in whether various X-ray methods for the evaluation of hip dysplasia are comparable with the biomechanical evaluations. In order to better understand the treatment of hip dysplasia, it is necessary to determine the distribution of forces and pressures in the hip joint in addition to using clinical and X-ray evaluations.

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METHODS

Preoperative standard antero-posterior X-ray images of the hips and pelvis of 35 adult subjects who had been operated on in the Department of Orthopaedic Surgery, Medical Centre Ljubljana between 1980 and 1989 due to unilateral/bilateral hip dysplasia were analysed. In total, 42 spherical congruent adult hips were analysed. X-ray image indicators of hip dysplasia were measured: the centre-edge angle - J_{CE}, the transverse acetabular inclination angle - J_{US}, the acetabular index of the weight-bearing zone - J_{AC}, the ACM angle - J_{ACM} and the hip value - HV [1]. All the measured values were graded according to the deviation from the normal value on a scale of 1 to 4 [1]. Peak contact stress (p_{max}) in the weight-bearing area of the hip was calculated by using the HIPSTRESS computer system [2, 3]. The parameters that influence the distribution of p_{max} in the hip joint were assessed from standard antero-posterior X-ray images with the HIJOMO computer aided system [4]. We calculated the correlation between p_{max} and the X-ray image indicators of hip dysplasia (J_{CE}, J_{US},J_{AC}, J_{ACM}, and HV).

RESULTS AND DISCUSSION

The average values of the X-ray parameters were: J_{CE}: 9.9°±8.1°; J_{US}: 47.6°±4.4°; J_{AC}: 23.8°±8.2°; J_{ACM}: 48.5°±6.1°; HV: 25.0±8.3. The average value of p_{max} was 7,33 MPa ± 3,50 MPa. All the values of the X-ray parameters were graded according to the deviation from the normal value on a scale of 1 to 4.

Tab. 1. The distribution of the measured hips across 4 grades for J_{CE}, J_{US},J_{AC}, J_{ACM}, HV.

	Grade 1 (%)	Grade 2 (%)	Grade 3 (%)	Grade 4 (%)
ϑ_{CE}	0	15.7	68.8	15.7
ϑ_{US}	16.7	23.8	23.8	35.7
ϑ_{AC}	16.7	14.3	23.8	45.2
ϑ_{ACM}	54.8	28.6	14.3	2.3
HV	14.3	21.4	38.1	26.2

We found a statistically significant correlation between p_{max} and the X-ray image indicators of hip dysplasia J_{CE}, J_{US} and J_{AC} ($P < 0,05$). The correlation between p_{max} and J_{ACM} and HV is not statistically significant ($P = 0.12$ and $P = 0.06$ respectively). All the measured hips are dysplastic according to the measurement of J_{CE}. Some of the hips in our study are normal according to measurement of

J_{US}, J_{AC}, J_{ACM} and HV. Although there is statistically significant correlation between p_{max} and J_{CE}, J_{US} and J_{AC}, we can not predict the stress in the weight-bearing area for individual patients if we only take in consideration J_{CE}, J_{US} and J_{AC}. Many pelvic geometrical parameters influence the value of hip joint pressure. It is proposed that p_{max} should be calculated before we decide on an operation, and complex hip geometry should be taken into account to predict the development of arthrosis in a dysplastic hip.

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