such as CDH. Our objective is to evaluate whether the D repeat polymorphism is associated with CDH in Han Chinese population.

**Methods:** The D repeat polymorphism was genotyped in 302 patients who suffered from CDH and 454 control subjects, and the allelic association of the D repeat was examined.

**Results:** From D 11 to D 18, 8 alleles were identified. D 13 allele is the most common allele both in control and CDH groups, the frequencies is 66.5 and 58.5 respectively. In CDH group, significant higher frequency of D 14 allele and significant lower frequency of D 13 was observed, the D14 allele was significantly over-represented in CDH patients (P=0.00014, odds ratio 2.20, 95% confidence interval 1.45-3.33) relative to D13 allele (Table 1). The association of D14 and D13 was found in females after stratification by gender, and in dislocation and subluxation patients after stratification by severity. There was no significant difference in any other alleles we examined.

**Conclusions:** Our results show an obvious association between the D repeat polymorphism of ASPN and CDH. It indicates that ASPN is important regulator in the etiology of CDH.

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**IMPEINGMENT AND THE RELATION WITH OSTEARTHRITIS OF THE HIP IN A POPULATION OF RETIRED SOCCER PLAYERS AND CONTROLS**


**Erasmus MC, Rotterdam, Netherlands**

**Purpose:** Recent research suggests that many cases of ‘idiopathic’ hip OA are in fact secondary to minor, subclinical shape deformities, which follow the mechanism of femoro-acetabular impingement (FAI). A type of FAI called cam impingement, might be the reason for the high risk for hip OA among professional soccer players. It comprises an abutment of the femoral head onto the acetabulum, due to an aspherical femoral head or a more convex head-neck junction. Hypothetically it is more present in young, active males compared to the general population.

However, recent research suggested that cam impingement and the relation with OA are not specific for soccer players, but might be present in the general population. In this study we explored the relation between shape of the hip, cam impingement and the relation with OA.

**Methods:** A Statistical Shape Model (SSM) was created of the shape of the proximal femur and acetabulum in AP x-rays of the hip. This model results in a set of independent modes that together quantitatively describe the total shape, while each mode separately describes a specific characteristic of the shape. Furthermore, we measured the alpha angle and the triangular index and applied a visual gradation for cam impingement.

The SSM comprised 83 x-rays of retired soccer players, 51 x-rays of OA controls and 75 x-rays of controls without OA. The OA controls are part of the GOAL cohort, which consists of patients with mild OA of the hip. The non-OA control group is part of the ERGO cohort and were selected on absence of complaints of the hip and of radiographic signs of OA. All subjects were male with similar age and BMI.

T-tests were used to test differences in alpha angle, triangular index and shape aspects with respect to impingement status. A General Linear Model was used to test the effect of group membership and OA (KL>1) on the various shape aspects.

**Results:** Two shape aspects were associated with impingement status. The first relates impingement to a more lateral extension of the femoral head and a decreased superior offset (blue line in figure; mode 5, p<0.001). This shape aspect was significantly associated with OA (p<0.001) and especially prominent in the controls with clinical OA, irrespective of radiological status. The second shape aspect relates impingement to a more stretched appearance of the femur with a decreased superior offset (mode 7, p<0.005). This shape aspect resembles the classical pistol grip deformity and was not associated with OA.

The alpha angle was not significantly higher in impingement cases. The triangular index was significantly higher (p<0.001) for impingement in general, but not for cases with a pistol grip deformity. A high index was associated with OA and often attributable to osteophytes.

**Conclusions:** Although the alpha angle and the triangular index are used in literature to assess cam-type deformity, our results show that they have only limited validity in AP x-rays. This might partly be due to the fact that these measures aim to quantify one specific deformity while our results show that impingement has to be attributed to multiple shape deformities.

The impingement related modes were not significantly different for soccer players compared to controls. This seems to confirm that impingement is not specific for soccer players, but is present in the general population.

We found that impingement comprises at least two independent shape deformities, of which only one was associated with OA (mode 5). Interestingly, the shape aspect that most closely represented a pistol grip was not associated with OA.

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**LONGITUDINAL ANALYSIS OF PROGRESSION IN HIP OSTEOARTHRITIS OVER 6 YEARS, USING A COMPUTATIONAL, AUTOMATED ALGORITHM**

**T. Shiom1, T. Nishii1,2, T. Sakai1, M. Takao1, T. Hanaouchi1, I. Nakahara1, K. Tsuda1, H. Yoshikawa1, N. Sugano1,2**

1Dept. of Orthopaedic Surgery, Osaka Univ. Graduate Sch. of Med., Osaka, Japan; 2Dept. of Orthopaedic Med. Engineering, Osaka Univ. Graduate Sch. of Med., Osaka, Japan

**Purpose:** In radiological assessment of hip osteoarthritis, minimal joint space width (mJSW) is widely used as a potent surrogate of disease progression. However, conventional, manual measurements of mJSW have limited sensitivity and reproducibility to
assess subtle change of JSW for longitudinal observation of hip osteoarthritis. We have developed a computational program which allows automatic measurement of mJSW. The purpose of the present study was to investigate natural course of patients with hip osteoarthritis and to examine potential risk factors for progressive joint space narrowing.

**Methods:** Fifty-three patients (73 hips) who consulted to our hospital in 1997-2000 and received annual examinations over 6 years without surgical intervention, were enrolled. There were 9 men and 44 women, and mean age was 48.8 years (range 21-73 years) at the initial examination. The initial radiograph showed Kellgren/Lawrence (K/L) grading of 1/2/3 in 23/36/14 hips, respectively. Mean duration of followup was 8.9 years (range 6-12 years) and anteroposterior pelvis radiographs were obtained annually. On a custom-made computational software, an operator manually identified the 5 seed points including bilateral tear drops, lateral rim and medial extreme of the acetabular roof, and approximate center of the femoral head. The, center edge (CE) angle, Sharp angle, center of the femoral head with respect to the tear drop, mJSW, and localized mJSW at the 3 equally subdivided locations (medial, intermediate, and lateral) of the weight-bearing were calculated automatically. We evaluated longitudinal change of mJSW of all patients and examined potential risk factors for progressive narrowing of mJSW, including CE angle, Sharp angle, initial K/L grading.

**Results:** The initial average mJSW was 3.39±2.75mm, and localized medial/intermediate/lateral mJSW was 2.91±2.64mm/2.85±1.91mm/3.72±3.33mm, respectively. From overall patterns of progression of mJSW during followup, we divided the group into 2 subpopulations; progressive and non-progressive OA groups using the threshold of 1.0mm decline of mJSW during the followup. There were 34 hips in progressive OA group, and 39 hips in non-progressive OA group. In progressive OA group, 12/8/14 hips had most declined JSW at medial/intermediate/lateral location, respectively. There was a significant association between the intermediate/lateral mJSW decline at the last radiograph and initial Sharp angle (r=0.38/0.54, respectively), while there was not a significant association between K/L grading and the decline in mJSW.

**Conclusions:** Radiographic hip mJSW was reliably quantified during longitudinal followup using a computational, automated software on standard radiographs. The results suggested that hip joint space measurement may be a practical and reliable method of assessing disease progression and detecting patient with high risk of subsequent progression of OA.

**FEMORAL HEAD DEFORMITIES OF OSTEOARTHRITIS OF THE HIP SECONDARY TO ACETABULAR DYSPLASIA**

K. Chiba
Nagasaki Univ., Nagasaki, Japan

**Purpose:** The femoral head shows various deformities in osteoarthritis of the hip secondary to acetabular dysplasia. They cause hip dysfunctions and influence the selection of the operative method. We investigated the factors associated with femoral head deformities.

**Methods:** 92 advanced and unilateral osteoarthritis of the hip secondary to acetabular dysplasia cases were investigated retrospectively. We classified the factors composing femoral head deformities into 3 bone reactions: femoral head compression, capital drop, and superior cervical osteophytes. They were evaluated by superposing inverted contralateral normal femoral head on anteroposterior radiographs. According to the combinations of these deformity factors, femoral heads deformities were classified into 8 types. We analyzed the relationship between these deformity factors and types and other radiological and clinical parameters.

**Results:** Femoral head compression was observed in older patients with posterior pelvic tilt, exhibiting bad walking ability and ADL. Capital drop was observed in younger patients with hip joint subluxation. Superior cervical osteophytes were observed in younger patients. Type 1 deformity (24%), defined by femoral head compression without osteophytes, was characterized by old age, late onset, pelvic posterior tilt, a worse walking ability and ADL. Type 8 deformity (23%), defined by both osteophyte formation without femoral head compression, was characterized by young age, early onset, hip subluxation, dysplastic acetabulum, superior shifted head, pelvic anterior tilt, and better ADL.

**Correlation between Deformities Factors and Radiological and Clinical Factors**

<table>
<thead>
<tr>
<th></th>
<th>FH Compression (mm)</th>
<th>Capital Drop (mm)</th>
<th>Sup. Cervical Osteophyte (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y.o.)</td>
<td>r=0.496 p&lt;0.001*</td>
<td>r=0.346 p&lt;0.01</td>
<td>r=0.475 p&lt;0.001*</td>
</tr>
<tr>
<td>Center-Edge Angle</td>
<td>0.186 0.076</td>
<td>0.436 &lt;0.001*</td>
<td>-0.212 0.042</td>
</tr>
<tr>
<td>Acetabular Angle</td>
<td>-0.228 0.029</td>
<td>0.239 0.022</td>
<td>0.200 0.057</td>
</tr>
<tr>
<td>Head Lateral Shift</td>
<td>-0.068 0.519</td>
<td>0.513 &lt;0.001*</td>
<td>0.188 0.073</td>
</tr>
<tr>
<td>Head Superior Shift</td>
<td>0.157 0.133</td>
<td>0.322 0.002</td>
<td>0.204 0.052</td>
</tr>
<tr>
<td>Pelvic Anteroposterior Tilt</td>
<td>-0.490 &lt;0.001*</td>
<td>0.292 0.010</td>
<td>0.323 0.004</td>
</tr>
<tr>
<td>Pelvic Lateral Tilt</td>
<td>-0.107 0.309</td>
<td>0.107 0.310</td>
<td>0.193 0.066</td>
</tr>
<tr>
<td>Onset of Coxalgia (y.o.)</td>
<td>0.465 &lt;0.01*</td>
<td>-0.473 &lt;0.001*</td>
<td>-0.499 &lt;0.001*</td>
</tr>
<tr>
<td>Pain</td>
<td>-0.099 0.357</td>
<td>0.122 0.259</td>
<td>0.057 0.597</td>
</tr>
<tr>
<td>ROM / Flexion</td>
<td>-0.377 &lt;0.001</td>
<td>-0.010 0.928</td>
<td>0.121 0.260</td>
</tr>
<tr>
<td>Walking Ability</td>
<td>-0.406 &lt;0.001*</td>
<td>0.177 0.099</td>
<td>0.273 0.010</td>
</tr>
<tr>
<td>ADL</td>
<td>-0.456 &lt;0.001*</td>
<td>0.158 0.141</td>
<td>0.386 &lt;0.001</td>
</tr>
</tbody>
</table>

**Conclusions:** We believe our data is useful in understanding the etiology of femoral head deformities. Additionally, we might be able to predict the progression of the femoral head deformity based on radiographs of the pelvis. It may also be possible to predict the clinical progression based on the shape of the femoral head.

**MORPHOLOGICAL CHANGES OF CAPSULE AFTER IMMOBILIZATION IN A RAT KNEE CONTRACTURE MODEL**

Y. Onoda, Y. Hagiwara, A. Ando, E. Chimoto, H. Suda, E. Itoi
Tohoku Univ. Sch. of Med., Sendai, Japan

**Purpose:** The definition of a joint contracture is a limitation of range of motion (ROM). Causes of joint contracture are classified into two types of components, artrogenic and myogenic ones. From our previous studies, ROM was restricted even after periarticular myotomies and was regained after capsulectomy, which suggested the artrogenic components were more important as causes of joint contracture. The purpose of this study was to evaluate the morphological and morphometric changes of the synovial membrane and capsule in a rat knee contracture model.

**Methods:** Animals. Total of 84 adult male Sprague-Dawley rats (body weight 380-400 g) was used. Unilateral knee joints were rigidly immobilized at 150° of flexion by internal fixator for 3 days, 1, 2, 4, 8, and 16 weeks. The immobilized animals and the sham