

Summary of Phd Thesis by Incze-Bartha Zsuzsánna:
Evaluation of the efficiency of treatment in hip dysplasia with corrective osteotomies around the hip

Key words: developmental hip dysplasia, children, hip osteotomy, femur osteotomy, subject specific modelling, finite element analysis hip

The goal in the treatment of developmental hip dysplasia is to recreate the normal anatomy of the hip with corrective osteotomies. The term of developmental hip dysplasia includes the deformation of acetabular dysplasia, subluxation, and luxation of the femoral head, which can occur before or after the birth. The used pelvic corrective osteotomies can be: reconstructive or salvation osteotomies. Regarding the femur the most used osteotomies are at the level of intertrochanteric region. One-stage operations are combination of pelvic or femoral osteotomy with open reduction of the femoral head. The used osteotomy type in the treatment of hip dysplasia depends from the patients age, the morphological aspect of the hip and the surgeons experience.

We studied the clinical and radiological results in the case of 49 patients with congenital hip dysplasia who were treated with corrective osteotomy. The performed osteotomies at the level of the pelvis were Pemberton, Dega, Salter, Chiari, triple osteotomy and on femur: varisation, derotation or shortage Pauwels osteotomy.

In 49% of the treated hips the operations were combined: pelvic osteotomy with femoral osteotomy, or open reduction with corrective osteotomy. The clinical results we have evaluated with the McKay clinical score. We had excellent results in 49%, and good results in 35% of the treated cases.

For easing the radiological study we developed the software "Coxomet", which allowed us to have exact measurements from the x-rays. We conducted a separate study following the punctuality of the measurements between two methods from the x-rays: manually and digitally. Major differences were measured in the case of complex radiological parameters: ACM, Sharp angle, and the Smith ratio.

To quantify the effects of the corrective osteotomies we evaluated the radiological results after our classification which was based on the modification of the Wiberg angle and Smith's ratio. The postoperative results for patients treated with combined osteotomies of the pelvis and femur the average class change was 2.5 classes. In the case of patients treated with one-stage operation the average class change was 2.7 classes. To detect the complication rate and the frequency of the healing problems we divided the studied patients group in two categories under and above of the age of eight years.

After analysing all the data we concluded that not only the group above age of eight years healed better, but they had fewer complications. In the group of patients under 8 years the avascular necrosis of the femoral head appeared in 4 cases, in the group above 8 years only in one case. We had seven redislocations in the group of patients under 8 years old, and 3 in the group of patients above 8 years.

To evaluate efficiency of the corrective osteotomies around the hip is important to understand the biomechanics of the normal and dysplastic hip. It is impossible to make in vivo measurements in the child's hip, but the finite element analysis of the immature hip gives us the modality to biomechanically evaluate the hip. With this method we can have immediate results from the corrective osteotomies.

We have built our hip models based on the computer tomographic data from two patients one with normal hip, and one with dysplastic hip. We performed virtual corrective hip osteotomies at the level of pelvis: Dega, Pemberton, Tönnis, Chiari, Ganz osteotomies, and Pauwels varisation osteotomy at the level of femur. In every hip model we performed a biomechanical analysis with the method of finite element analysis.

The von Mises stress distribution in the dysplastic hip had a more lateral trajectory as in the normal hip. In the dysplastic model the von Mises stress started at the level of the sacro-iliac joint went over the femoral head through a point like contact area and exited at the level of the lesser trochanter. The measured values in the region of the femoral head and major trochanter were higher in the dysplastic model. This trajectory moved to medial after the hip osteotomies, but didn't reached its normal position like in the normal hip model. In every post osteotomy model the values of the intraarticular contact pressures decreased compared to the dysplastic model. The closest von Mises stress trajectory and contact pressure distribution to the normal model we have find in the Dega and Ganz post osteotomy models. The measured values of the von Mises stress in the osteotomy sites were elevated, excepting in the model after Chiari osteotomy.

Although the biomechanical values of a normal hip were not replicated by any of the post osteotomy models, we were able to determine the most efficient corrective osteotomy, which was the Dega pelvic osteotomy combined with the reduction of the femoral head and the Pauwels varisation femur osteotomy.

Performing the virtual corrective osteotomies to treat the congenital hip dysplasia, and analysing the post osteotomy hip with the method of finite element analysis, we were able to make a proper preoperative planning for the real corrective osteotomy by having the best outcome already analysed.