

The Biomechanical Analysis of Pelvic Osteotomies Applied for Developmental Dysplasia of the Hip Treatment in Pediatric Patients

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Abstract : Developmental Dysplasia of the Hip (DDH) is a frequent pathology in pediatric orthopedist's practice. Neglected or residual cases of DDH in walking patients are usually treated using pelvic osteotomies. Plastic changes take place in hinge points due to acetabulum reorientation during surgery. Classically described hinge points and a traditional division of pelvic osteotomies on reshaping and reorientation are currently debated. The purpose of this article was to evaluate biomechanical changes during the most commonly used pelvic osteotomies (Salter, Dega, Pemberton) for DDH treatment in pediatric patients. Methods: virtual pelvic models of 2- and 6-years old patients were created, material properties were assigned, pelvic osteotomies were simulated and biomechanical changes were evaluated using finite element analysis (FEA). Results: it was revealed that the patient's age has an impact on pelvic bones and cartilages density (in younger patients the pelvic elements are more pliable - $p < 0.05$). Stress distribution after each of the abovementioned pelvic osteotomy was assessed in 2- and 6-years old patients' pelvic models; hinge points were evaluated. The new term "restriction point" was introduced, which means a place where restriction of acetabular deformity correction occurs. Pelvic ligaments attachment points were mainly these restriction points. Conclusions: it was found out that there are no purely reshaping and reorientation pelvic osteotomies as previously believed; the pelvic ring acts as a unit in carrying out the applied load. Biomechanical overload of triradiate cartilage during Salter osteotomy in 2-years old patient and in 2- and 6-years old patients during Pemberton osteotomy was revealed; overload of the posterior cortical layer in the greater sciatic notch in 2-years old patient during Dega osteotomy was revealed. Level of Evidence – Level IV, prognostic.

Keywords : developmental dysplasia of the hip, pelvic osteotomy, finite element analysis, hinge point, biomechanics

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