Biomechanical Analysis of Hip Function After Chiari Pelvic Osteotomy

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Summary. The reasons are discussed for differences in functional results of the pelvic osteotomy after Chiari, regardless of the fact that the CE and AC angles were equal in all patients. When lateralization and distal displacement of the greater trochanter were performed in addition to the pelvic osteotomy, the functional results proved to be better. Biomechanical analysis of the relationship between gluteal force and body weight revealed that these relations change; in all examined cases where lateralization and distal displacement of the greater trochanter were performed, the relationship proved postoperatively to be considerably more favorable. In the same group of patients, the relationship between the force of reaction and body weight was also changed after surgery. Therefore, lateralization and distal displacement of the greater trochanter are important factors for the undisturbed functioning of a hip; in all examined patients the functional results were better when lateralization and distal displacement of the greater trochanter were performed.


Pelvic osteotomy was described by Chiari in 1953 [5–7] and this method has since found worldwide application [1, 11, 12, 16]. The basic indications for pelvic osteotomy are acetabular dysplasia with a CE angle of less than 5°, femoral head displacement, and hip arthrodesis after Schneider. Pelvic osteotomy is applied in adolescent and adult patients, and occasionally for hip arthroplasty in dysplastic acetabula [3, 4, 15, 19]. The surgery consists of a pelvic osteotomy at the upper edge of the acetabulum, immediately above the joint capsule attachment, and medialization of the distal segment and lateralization of the proximal segment of the osteotomized pelvis. This results in femoral head coverage by the proximal segment of the pelvis with joint capsule interposition. Distal segment medialization causes acetabulum verticalization, meaning that the quality cartilage surface of the load-bearing areas will further decrease with a dysplastic acetabulum [10]. As a rule, a new acetabular area of satisfactory size is obtained on the other side, and the acetabulum is separated from the femoral head by an interposed joint capsule.

The surgery may be extended by supplementary lateralization and distal displacement of the greater trochanter and by intertrochanteric (varus, possibly derotation) osteotomy, during the same operation or subsequently (Fig. 1). The Chiari pelvic osteotomy itself causes significant biomechanical changes in the...
Fig. 1. a Hip-joint roentgenograms before surgery and b after the Chiari pelvic osteotomy with simultaneous lateralization and distal displacement of the greater trochanter, and intertrochanter derotation osteotomy

Fig. 2a-d. Changes in mechanical relations within the hip joint after the Chiari pelvic osteotomy and lateralization and distal displacement of the greater trochanter

The changes may be either favorable, as when femoral head medialization and shortening of the medial lever-load-arm $x$ is achieved, or unfavorable, as when shortening of the obductor muscles and reduction in the resulting gluteal force $F_{ge}$ (Fig. 3) and therefore partial insufficiency of the muscles is caused, or where force-arm $y$ (Fig. 2) does not change considerably. The changes are even more noticeable when the pelvic osteotomy is combined with intertrochanteric varus osteotomy (Fig. 2c). Here, in addition to the above-mentioned changes, the greater trochanter is raised and insufficient abductor muscles are shortened, with possible shortening of the lateral lever-force-arm $y$. As a rule, such patients limp and show a positive Trendelenburg’s sign. We were of the opinion that intertrochanteric varus osteotomy should be supplemented by lateralization and distal displacement of the greater trochanter, and this was confirmed by our clinical cases. This offers an opportunity to influence successfully the establishment of a normal biomechanical relationship within the hip joint, even without performing varus osteotomy.

Lateralization and distal displacement of the greater trochanter (Fig. 2d) not only lengthen the lateral level-force-arm $y$ (with an already shorter load-arm $x$) but also establish a physiological distance for abductor muscle insertion, which is no doubt an important factor affecting normal functioning. The treatment results are checked both clinically and radiolog-