

## Abstract

In the case of a high-energy injury (traffic accident, fall from above), a pelvic ring injury with vertical instability and/or a sacrum injury with spinopelvic instability may occur. Such instabilities threaten the basic functions of the pelvic ring and lumbosacral junction. Adequate transmission of body and limb load is not possible through such injured segments. The solution is some form of reduction and stabilization to achieve the restoration of anatomical conditions and a gentle and firm connection.

Spinopelvic dissociation in some cases accompanying pelvic ring fractures and / or damages is a complex injury with a difficult solution. The frequency of occurrence is reported in the literature 2.9–3.1 %. The number of such accidents is on the rise with higher density and aggressiveness of traffic, the great popularity of dangerous human activities and the accelerating pace of life. Most of these fractures are treated surgically, non-surgical treatment is reserved only for patients who are unable to undergo surgery for internal or local reasons. In our study group, we evaluated a group of patients with a pelvic ring fracture and / or sacral fracture with spinopelvic dissociation who were treated at our workplace in the period 2009–2019. During this period, 222 patients with a pelvic fracture were surgically treated here. The total number of patients treated with spinopelvic fixation was 15. The mean age of the patients was 34.4 years (range 14–56 years).

We evaluated fractures according to the classification of AO, Denis, Roy–Camille and morphologically. We noticed Denis II type fractures in 26.7 % and Denis III type fractures in 73.3 %. According to Roy–Camille, these were type 1 fractures in 36.4 %, type 2 fractures in 27.3 % and type 3 fractures in 36.4 % of cases.

Our cohort is retrospectively evaluated and includes only surgically treated patients. Complications recorded in our group include infection, implant prominence or nonunion. We did not notice a failure of osteosynthesis. In the experimental part, a transforaminal unilateral linear and comminutive pelvic ring fracture was simulated on a finite element model. On the anterior segment of the pelvis without fixation, in the posterior segment using spinopelvic fixation. We dealt with the biomechanics of force transmission in the fracture area for individual types of osteosynthesis and its use in practice. The aim of the study was to determine the biomechanical properties of different types of spinopelvic fixations used in the treatment of vertically unstable pelvic fractures or spinopelvic dissociation.

The behavior of the pelvic ring, lumbopelvic junction and implants was analyzed by experiment on a finite element model. Using CT scans, a finite element model of the pelvis was created. A Denis II fracture was simulated, with a linear and comminutive fracture line, fixed by bilateral lumbopelvic fixation with polyaxial screws in both L4 and/or L5 pedicles and in both iliac bones (both sides connected by a crossbar). A force of 500 N was applied to the upper cover plate of the L4 vertebra. The graphical output of the experiment was color mapping and data in the form of graphs of the dependence of the size of the load on the dislocation.

The study was carried out in cooperation with the NTIS research center at the Faculty of Applied Sciences, UWB in Pilsen. It was confirmed to us that the longer arm of the lumbopelvic fixation force shows higher strength regardless of the number of screws, and that the ISS will increase the strength of the whole assembly. For the most severe bilateral sacral fractures the most reliable combination is lumbopelvic bilateral in combination with ISS.

It has been demonstrated in patient populations that soft tissue injuries and the neurological deficit accompanying injuries are serious obstacles to the treatment of these fractures. A kyphotic dislocation of the sacral fracture is also a big problem. It has been shown to be associated with persistent neurological deficits. It reduces the pelvic size and causes defects in the levator ani muscle and labor complications in women.

The choice of the type of stabilization is determined by the type of fracture and the degree of instability. The most suitable method of treatment for Denis I fractures is ISS, for Denis II without vertical instability TIFI, for Denis III fractures the method of choice is clearly spinopelvic fixation. The surgeon should be educated not only in the pelvic and spinal skeletal issues, but also in the issues of epidural and pelvis surgery. The patient clearly benefits from a correctly indicated, early operation and an optimally repaired fracture. Intensive rehabilitation is an integral part.

The number of these injuries and the related evidence of base medicine will probably be poor in the period ahead. There is no ease in efforts and further research, either in the field of the study of lumbosacral and sacropelvic mechanics, or in the field of repositioning and surgical techniques. The main methods in the future will be polyaxial pedicular, iliosacral and iliac screws.