Rotationally and vertically unstable injuries to the pelvic ring (Type C) require stabilisation of the anterior and posterior pelvic ring complex. Inadequate treatment of these injuries leads to chronic instability of the pelvic ring, which can finally cause permanent disability. Open reduction and stable internal fixation of the anterior and posterior complex of unstable pelvic ring injuries are standard procedures in the treatment of hemodynamically stable patients with (Type C) pelvic injuries. Our aim is to show that this type of treatment achieves excellent and good results. All patients were operated on using the method of open reduction and anterior plate fixation of sacroiliac complex as well as fixation of the pubic symphysis. We present a retrospective study of the results concerning the treatment of 19 patients with (Type C) unstable pelvic injuries. The average age of the patients was 43.21 years old. The final functional results, 2 years post-surgery according to the Majeed scoring system and the results were excellent in 11 (57.89%) and good in 8 (42.1%) patients. There were no bad results to report. Type C pelvic ring injuries are unstable and unless they are adequately treated, they can lead to permanent consequences. Surgical treatment that includes open reduction and stable internal fixation of the anterior and posterior pelvic ring complex leads to excellent and good results. The patients that were treated surgically by fixation of the anterior and posterior pelvic ring complex return to their everyday lives and work activities.

Key words: unstable pelvic injury, surgical treatment.

INTRODUCTION

Pelvic injuries encompass a wide spectrum of injury patterns, associated visceral and neurologic injuries, and outcomes. Biomechanical instability of the pelvis may provoke hemodynamic instability in the acute phase because the disrupted pelvic ring leads to damage to the many vessels adherent to the pelvic and sacral bones. The unstable pelvic ring also results in pelvis mobility, which left untreated may cause permanent disability. The primary goal in the treatment of hemodynamically stable patients with pelvic ring injuries is prevention of malunion. Malposition of one hemipelvis relative to the other can result in any or all of the following conditions, and surgery is indicated to prevent or mitigate the likelihood of their occurrence: leg length inequality and mechanical low back pain, sitting imbalance, dyspareunia and bowel and bladder dysfunction. With purely ligamentous injuries (for example, symphyseal disruptions and sacroiliac (SI) joint dislocations), persistent "instability" and chronic pain, in addition to malunion, must also be considered as the possible sequelae of a pelvic ring injury. In this paper we present the results concerning the treatment of hemodynamically stable patients with unstable AO/OTA Type C pelvic injuries.

OBJECTIVE

Open reduction and stable internal fixation of the anterior and posterior complex of unstable pelvic ring injuries are standard procedures in the treatment of hemodynamically stable patients with (Type C) pelvic injuries. Our aim is to show that this type of treatment achieves excellent and good results.

METHODS

In our retrospective study we followed 19 patients with AO/OTA Type C pelvic injuries (Figure 1).The Tile classification system is based on the stability and mechanism of injury, and its concept served as the foundation for the AO/OTA classification: Type A injuries consist of fractures that do not compromise the integrity of the pelvic ring, such as iliac wing avulsion fractures and nondisplaced fractures in more than one site. These fractures are considered stable. Type B injuries involve the pelvic ring in two or more sites and create a segment that is rotationally

Surgical treatment of the unstable type c pelvic injury

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unstable but vertically stable due to the incomplete disruption of the posterior sacroiliac ligamentous complex. Type C injuries are both rotationally and vertically unstable due to complete disruption of the posterior ligamentous and/or bony complex. They are caused by high-energy traumas on the vertical axis of the pelvic ring. The diagnostic procedure included X-rays diagnostics, and for some patients an additional CT scan. All patients were operated on using the method of open reduction and anterior fixation of sacroiliac complex as well as fixation of the pubic symphysis. To evaluate the final functional results, the Majeed scoring system was used (Table 1).

RESULTS

We present a retrospective study of the results concerning the treatment of 19 patients with unstable Type C pelvic injuries. The patients were operated on at the Clinic for Orthopaedic Surgery and Traumatology in Niš and at the Clinic for Traumatology in Skopje. The average age of the patients was 43.21 (from 21 to 65) years old. There were 11 male and 8 female patients. Thirteen patients sustained traffic accident injuries, and 6 patients sustained injuries related to falls from greater heights. Ten patients suffered from an isolated pelvic ring injury, and 9 patients had a pelvic injury accompanied by limb injuries. All patients were operated on between 4 and 7 days after hospitalization, 4.3 days on the average. The method of open reduction and internal fixation of the anterior and posterior pelvic ring complex was used for all patients. In all patients, posterior sacroiliac instability was treated using the method of anterior fixation with two plates. In all patients, anterior complex (rupture of the pubic symphysis) was treated with a plate with 4 screws. Other methods of fixation, such as external fixation, were not used because, according to the hemodynamic instability score, there was no need to apply the protocol "damage control orthopaedics", i.e. no patient was polytraumatized. No post-surgical infections occurred, one (5.1%) patient had a deep vein thrombosis (DVP). Post surgery all patients were activated, sitting was allowed as well as walking with crutches.

<table>
<thead>
<tr>
<th>Pain</th>
<th>Intense, continuous at rest 0 to 5</th>
<th>Intense with activity 10</th>
<th>Tolerable, but limits activity 15</th>
<th>with moderate activity abolished by rest 20</th>
<th>Mild, intermittent, normal activity 25</th>
<th>Slight, occasional or no pain 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting</td>
<td>Painful 0 to 4</td>
<td>Painful if prolonged or awkward 6</td>
<td>Uncomfortable 8</td>
<td>Free 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexual intercourse</td>
<td>Painful 0 to 1</td>
<td>Painful if prolonged or awkward 2</td>
<td>Uncomfortable 3</td>
<td>Free 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking aids</td>
<td>Bedridden or almost 0 to 2</td>
<td>Wheelchair 4</td>
<td>Two crutches 6</td>
<td>Two sticks 8</td>
<td>One stick 10</td>
<td>No sticks 12</td>
</tr>
<tr>
<td>Gain unaided</td>
<td>Cannot walk or almost 0 to 2</td>
<td>Shuffling small steps 4</td>
<td>Gross limp 6</td>
<td>Moderate limp Slight limp 8 to 10</td>
<td>Normal 12</td>
<td></td>
</tr>
<tr>
<td>Walking distance</td>
<td>Bedridden or few metres 0 to 2</td>
<td>Very limited time ans 4</td>
<td>Limited with sticks, difficult without prolonged standing possible 6</td>
<td>One hour with a stick 8</td>
<td>One hour without sticks, slight pain or limp 10</td>
<td>Normal for age and general condition 12</td>
</tr>
<tr>
<td>Functional outcome (total score)</td>
<td>Excellent 78 to 80</td>
<td>Good 70 to 77</td>
<td>Fair 60 to 69</td>
<td>Poor &lt; 60</td>
<td></td>
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</tr>
</tbody>
</table>
tches without weight-bearing on the side where the instability of the pelvic ring was up to 10-12 weeks post-surgery. After 10-12 weeks, weight-bearing increased progressively with regular X-ray check-ups so as to prevent fixation loss. All patients had a follow-up of at least 2 years post-surgery. The final functional results were determined 2 years post-surgery according to the Majeed scoring system and the results were excellent in 11 (57.89%) patients and good in 8 (42.1%) patients. There were no bad results to report.

CASE REPORT

A patient, 27 years old, who was injured in a traffic accident was admitted to hospital. The patient sustained Type C pelvic injury together with open fractures of the left forearm and right lower leg (Figures 2-7). On admission to hospital, HIS (hemodynamic instability score) 3, i.e. systolic blood pressure of 100 mmHg was maintained by giving two litres of liquid, and later on approximately 250 ml an hour. Emergent surgeries of the forearm and lower leg fractures were performed. Both fractures were fixed by the Mitkovic’s external fixators. The patient was immunized, thromboembolic and antibiotic prophylaxis were used. Four days after fixation of limb fractures, another, open reduction was done together with internal fixation of pelvic instability. Posterior sacroiliac complex was treated by anterior approach and was fixed with two reconstructive pelvic plates and the pubic symphysis was fixed by a reconstructive plate with screws. In the early post-operative period, the patient was mobilised immediately after post-operative removal of drains. In the early and later post-operative period not a single complication related to the treatment occurred. The final functional result of the treatment was excellent, the overall Majeed score was 78. The patient returned to everyday activities 14 months post-injury.

DISCUSSION

In general, pelvic ring injuries can be caused by low-energy trauma in older patients with osteoporosis and by high-energy trauma in younger patients. Pelvic ring injuries can be isolated or accompanied by other injuries of the locomotory apparatus, injuries of small pelvic organs, blood vessels and nerves as part of polytrauma. In accordance with this, patients can be hemodynamically stable or hemodynamically unstable, their lives may be threatened.

Controlling and stopping bleeding in hemodynamically unstable patients is achieved by the pelvic clamp, external skeletal fixation, pelvic tamponade or embolization. The rate of mortality in hemodynamically unstable patients is approximately 10%. Mortality of the patient increases with the severity of the pelvic injury. The patient with a closed pelvic fracture who is hemodynamically unstable has a mortality of approximately 27%, which increases to approximately 55% for open pelvic fractures.

In this paper we present the results concerning the treatment of hemodynamically stable AO/OTA Type C pelvic ring injuries. The basic characteristic of rotationally and vertically unstable pelvic ring injuries (Type C) is high-energy impact on the vertical axis of the pelvic ring. These injuries can be unilateral (C1) and bilateral (C2). The pelvic ring can have the front opening, down the pubic symphysis or pubic bones, or the rear opening through the sacroiliac complex, when sacrospinous, sacrotuberous and anterior sacroiliac ligaments are broken.

FIGURE 2.
A-X-RAY OF SACROILIAC DISLOCATION OF THE RIGHT SACROILIAC JOINT AND DIASTASIS (RUP-TURE) OF THE PUBIC SYMPHYSIS (TYPE C INJURY); B- X-RAY AFTER OPEN REDUCTION AND INTERNAL FIXATION;
The aim of surgical stabilization of this pelvic injury is volume reduction, which results in reducing and stopping bleeding, reducing pain and preventing secondary consequences caused by nonunion and malunion. The stabilization methods are the pelvic C clamp, external skeletal fixation and internal fixation.

The pelvic clamp and external skeletal fixation have a significant role in the earlyemergent phase of the treatment of unstable pelvic injuries which are part of polytrauma and the treatment of unstable patients whose lives are threatened. These methods are used temporarily because they do not produce good results like definitive methods of treatment of Type C pelvic injuries. Open reduction and rigid internal fixation is the best method for definitive stabilization of these injuries. This treatment aims to achieve anatomical reduction, early mobilization of patients and pain relief. By early activation of the patients who were operated we reduce the possibility of the occurrence of deep vein thrombosis.

Literature describes approxima-tely 3% of deep vein thrombosis that occurred despite prevention. Prevention includes the use of low-molecular fraction heparin (LWMH), early surgical stabilization and early activation. The injury biomechanics itself makes internal fixation necessary both for the anterior and posterior pelvic ring structures. Anterior structures - the pubic symphysis is fixed by a reconstructive plate or a DCP plate with screws. Every diastasis of symphysis bigger than 2.5 cm is an indication for fixation. Posterior sacroiliac complex is fixed with two DCP plates using the front approach, or percutaneously, using a minimally invasive technique that requires surgical skill and a sound knowledge of the method.

Depending on the type of injury, methods of posterior fixation with a plate or sacral bars are also used to fix posterior sacroiliac complex. Posterior approach is often accompanied by the complications such as skin necrosis or wound dehiscence, which is why this method is slowly being replaced by the modern minimally invasive percutaneous fixation. In hemodynamically stable patients, immediately upon hospitalization supracondylar traction or traction through tuberositas tibiae should be placed. After establishing definitive diagnostics which includes clinical examination, laboratory analyses, X-rays (AP, Inlet, Outlet) and CT scan, definitive stabilization should be done, between 4 and 7 days after hospitalization. It is usually better to wait until the patient’s general state has improved, between 5 and 7 days after injury. Definitive stabilization of the pelvic ring allows early activation of the patient, reduces the possibility of early and later complications and allows the patient to return to everyday life and work activities. Unstable injuries treated by other type of non-operative or operative method lead to chronic instability of the pelvic ring, achieve bad treatment results and can cause permanent disability. Patients have a bad gait, limb length inequality, chronic pain in dorsal-lumbal region of the spine, sexual and urinary dysfunctions, which generally leads to permanent disability (Figure 8,9). (Polytraumatized patient with the injury of the head and the arm and internal abdominal bleeding, in-
jured in a traffic accident while riding a motorcycle. Initially, the patient was treated by the method of external skeletal fixation within the protocol "damage control orthopaedics".

Residual diastasis of the pubic symphysis and nonunion of posterior SI complex, since the method of external fixation was used as a definitive method of treatment. Clinically, pelvic instability is present, as well as pain after a longer period of sitting, standing and after a shorter period of walking.

The patient walks with an antalgic gait. The final functional outcome is bad, according to the Majeed scoring system, the score is 52.

In 1958, Pennal studied 359 cases, and reported to the Canadian Orthopaedic Association (unpublished) that patients with unstable vertical shear injuries had many late complications including nonunion. Raf, 1966, reported that after pelvic fractures some 33% of patients complained of moderate to severe discomfort, but that of those suffering a sacral fracture or a sacroiliac dislocation (52%) had severe symptoms. Slatis and Huittinen, 1972 and Monahan and Taylor 1974-5 also found a significant percentage of late musculoskeletal problems in patients after unstable pelvic injuries.

CONCLUSION

Type C pelvic ring injuries are unstable and unless they are treated adequately, they lead to permanent consequences. Surgical treatment which includes open reduction and stable internal fixation of both anterior and posterior complex of the pelvic ring leads to excellent and good results in the treatment. The patients were treated surgically, by fixation of both anterior and posterior complex of the pelvic ring, and they return to their everyday lives and activities.
SUMMARY

HIRURŠKO LEĆENJE NESTABILNIH POVREDA KAR-LICE TIPOA C

Rotatorno i vertikalno nestabilne povrede karličnog prstena (Tip C) zahtevaju stabilizaciju prednjeg i zadnjeg kompleksa karličnog prstena. Neadekvatno lečenje ovih povreda dovodi do hronične nestabilnosti karličnog prstena što za krajnu posledicu može da dovede do trajnog invaliditeta. Otvorena reposition i stabilna unutrašnja fiksacija prednjeg i zadnjeg kompleksa nestabilnih povreda karličnog prstena je standard u lećenju hemodinamski stabilnih pacijenata sa povredama karlice tipa C. Cilj nam je da pokazemo da se odlični i dobri rezultati postižu ovakvim načinom lečenja. Svi pacijenti su operisani metodom otvorene reposition i prednje fiksacije ploče, sakroilijačnog kompleksa i pubične simfize. Retrospektivnom studijom prikazujemo rezultate lečenja 19 pacijenata sa nestabilnim povredama karlice tipa C. Prosečna starost pacijenata je iznosila 43,21 godine. Krajnji funkcionalni rezultati, 2 godine od operacije prema Majeed-ovom skoring sistemu su odlični kod 11(57,89%) pacijenata i dobri kod 8(42,1%) pacijenata. Loših rezultata lečenja nije bilo. Povrede karličnog prstena tipa C su nestabilne i ako se adekvatno ne leče dovode do trajnih posledica. Hirurško lečenje koje podrazumeva otvorenu reposition i stabilnu unutrašnju fiksaciju prednjeg i zadnjeg kompleksa karličnog prstena dovodi do odličnih i dobrih rezultata. Pacijenti lećeni hirurški, fiksacijom i prednjeg i zadnjeg kompleksa karličnog prstena se vraćaju svojim svakodnevnim i radnim aktivnostima.

Ključne reči: nestabilne povrede karlice, hirurško lečenje.

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