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# IMPROVEMENT OF DIAGNOSTIC AND TREATMENT METHODS FOR COMBINED PELVIC INJURIES IN PATIENTS

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**Abstract**

Combined pelvic injuries represent one of the most severe categories of musculoskeletal trauma and are frequently associated with significant morbidity and mortality. The complexity of pelvic anatomy, the risk of massive hemorrhage, and the frequent coexistence of injuries to abdominal organs, the urinary tract, and neurovascular structures make diagnosis and treatment particularly challenging. Early recognition and appropriate management are essential for improving patient survival and functional outcomes. This article reviews contemporary diagnostic approaches and treatment strategies for combined pelvic injuries and highlights methods that can enhance clinical effectiveness. Particular attention is given to advanced imaging technologies, hemodynamic stabilization, minimally invasive surgical techniques, and multidisciplinary trauma care. The analysis demonstrates that the integration of modern diagnostic methods and evidence-based treatment protocols significantly reduces complications and improves long-term patient recovery.

**Keywords:** pelvic trauma, combined pelvic injuries, diagnosis, computed tomography, pelvic fracture, surgical treatment, polytrauma.

## Introduction

Pelvic fractures account for approximately 3–8% of all skeletal injuries but are associated with disproportionately high rates of mortality and disability. Combined pelvic injuries are particularly dangerous because they often occur in the setting of high-energy trauma such as road traffic accidents, falls from height, industrial accidents, and crush injuries. These injuries frequently involve damage not only to the pelvic ring but also to surrounding soft tissues, blood vessels, nerves, and internal organs.

The pelvis contains major vascular structures, including branches of the internal iliac artery and extensive venous plexuses. Consequently, severe pelvic fractures may lead to life-threatening hemorrhage. Studies have shown that uncontrolled bleeding remains one of the leading causes of death in patients with unstable pelvic fractures. In addition, concomitant injuries involving the abdomen, chest, spine, and extremities complicate the diagnostic process and delay definitive treatment.

Recent advances in trauma surgery, emergency medicine, and radiological diagnostics have improved the management of pelvic trauma. However, despite these developments, combined pelvic injuries continue to present significant challenges. Therefore, further refinement of diagnostic algorithms and treatment methods remains an important objective in modern traumatology and orthopedic surgery.

The purpose of this study is to evaluate current approaches to the diagnosis and treatment of combined pelvic injuries and to identify strategies that improve clinical outcomes.

## Materials and Methods

This study is based on a comprehensive review of scientific literature and the analysis of modern clinical practices in trauma centers. Publications from international peer-reviewed

journals, orthopedic textbooks, trauma surgery guidelines, and clinical reports published during the last decade were reviewed.

The following diagnostic methods were analyzed:

- Clinical examination;
- Conventional radiography;
- Computed tomography (CT);
- Three-dimensional CT reconstruction;
- Ultrasonography (FAST examination);
- Angiography and interventional radiology techniques.

The following treatment modalities were evaluated:

- Emergency hemodynamic stabilization;
- Pelvic binders and external fixation;
- Open reduction and internal fixation (ORIF);
- Percutaneous fixation techniques;
- Angioembolization;
- Multidisciplinary trauma management.

Comparative analysis was performed to determine the effectiveness of these methods in reducing mortality, improving fracture stabilization, and enhancing functional recovery.

## Results

### Diagnostic Improvements in Combined Pelvic Trauma

Accurate diagnosis is fundamental for successful treatment. Clinical examination remains the first step in patient assessment; however, physical findings alone are often insufficient due to the presence of multiple injuries and altered consciousness in trauma patients.

### Clinical Assessment

Initial evaluation should follow Advanced Trauma Life Support (ATLS) principles. Assessment of airway, breathing, circulation, disability, and exposure remains the priority. Signs suggestive of pelvic injury include:

- Pelvic pain and instability;
- Deformity of the pelvic ring;
- Lower limb shortening or rotation;
- Perineal hematoma;
- Hemodynamic instability;
- Hematuria and urinary retention.

Although manual testing of pelvic stability can provide useful information, repeated manipulation should be avoided because it may disrupt clot formation and exacerbate bleeding.

### Radiographic Evaluation

Anteroposterior pelvic radiography remains an important screening tool in emergency settings. It allows rapid identification of major fractures and dislocations. However, plain radiographs have limited sensitivity for complex fracture patterns.

### Computed Tomography

Multidetector CT has become the gold standard for diagnosing pelvic trauma. CT imaging provides detailed visualization of fracture morphology, displacement, and associated injuries.

Advantages include:

- High diagnostic accuracy;
- Identification of occult fractures;
- Detection of organ injuries;
- Evaluation of active bleeding.

Three-dimensional CT reconstruction further improves surgical planning by enabling precise visualization of fracture patterns and anatomical relationships.

**Angiography**

Angiography plays a critical role in patients with persistent hemodynamic instability despite resuscitation. It facilitates localization of arterial bleeding and allows therapeutic embolization, which significantly reduces mortality associated with pelvic hemorrhage.

**Treatment Strategies**

**Hemodynamic Stabilization**

The first priority in managing combined pelvic injuries is controlling hemorrhage and restoring circulatory stability. Massive blood loss may occur rapidly due to disruption of pelvic vessels and cancellous bone surfaces.

Modern resuscitation protocols include:

- Balanced transfusion strategies;
- Damage control resuscitation;
- Early administration of tranexamic acid;
- Continuous hemodynamic monitoring.

Pelvic binders should be applied as early as possible in suspected unstable pelvic fractures. These devices reduce pelvic volume and help control bleeding by stabilizing fracture fragments.

**External Fixation**

External fixation remains a valuable damage-control technique in unstable patients. It provides temporary stabilization while reducing hemorrhage and pain.

Advantages include:

- Rapid application;
- Minimal invasiveness;
- Improved hemodynamic stability;
- Facilitation of patient transfer and imaging.

External fixation is particularly beneficial during the initial management phase before definitive surgical reconstruction.

**Open Reduction and Internal Fixation**

ORIF is considered the standard treatment for many unstable pelvic fractures. This technique restores anatomical alignment and provides rigid stabilization.

Benefits include:

- Accurate fracture reduction;
- Improved biomechanical stability;
- Earlier mobilization;
- Better long-term functional outcomes.

However, ORIF requires extensive surgical exposure and may increase operative time and blood loss in critically ill patients.

**Minimally Invasive Percutaneous Techniques**

Recent developments have led to widespread use of percutaneous screw fixation. These techniques are performed under fluoroscopic or CT guidance and offer several advantages over traditional open surgery.

Clinical benefits include:

- Reduced soft tissue trauma;
- Lower infection rates;
- Decreased blood loss;
- Shorter hospital stays;
- Faster rehabilitation.

Percutaneous fixation has become particularly valuable in elderly patients and those with multiple injuries.

**Angioembolization**

Interventional radiology has revolutionized the treatment of pelvic hemorrhage. Selective arterial embolization effectively controls bleeding while avoiding extensive surgical intervention.

Studies have demonstrated high success rates in controlling arterial hemorrhage, making angioembolization an essential component of modern trauma care.

**Discussion**

The management of combined pelvic injuries has evolved significantly during the past two decades. Historically, treatment focused primarily on fracture stabilization. Contemporary approaches recognize that successful outcomes depend on coordinated management of the entire trauma patient.

The introduction of multidetector CT has dramatically improved diagnostic accuracy. Detailed imaging allows clinicians to classify injuries more precisely and select the most appropriate treatment strategy. Furthermore, three-dimensional reconstruction facilitates preoperative planning and reduces intraoperative complications.

Damage-control principles have become central to the management of severe pelvic trauma. Early stabilization using pelvic binders and external fixation reduces ongoing hemorrhage and improves patient survival. These interventions are particularly important during the critical first hours following injury.

Minimally invasive fixation techniques represent another major advancement. By minimizing soft tissue disruption and preserving blood supply, these procedures decrease complications while maintaining adequate stability. Consequently, patients experience shorter recovery periods and improved functional outcomes.

Multidisciplinary collaboration is equally important. Trauma surgeons, orthopedic surgeons, vascular surgeons, radiologists, anesthesiologists, and rehabilitation specialists must work together to optimize patient care. Evidence suggests that coordinated trauma teams achieve better survival rates and lower complication rates than isolated specialty-based management.

Despite these advances, challenges remain. Delayed diagnosis, limited access to advanced imaging, and inadequate trauma resources continue to affect outcomes in many healthcare settings. Future improvements should focus on standardized treatment protocols, enhanced trauma education, and expanded availability of modern diagnostic and interventional technologies.

**Conclusion**

Combined pelvic injuries remain among the most severe forms of traumatic injury due to their association with massive hemorrhage, multiple organ damage, and high mortality rates. Modern diagnostic methods, particularly computed tomography and angiography, have significantly improved the accuracy of injury assessment and treatment planning.

Early hemodynamic stabilization, prompt application of pelvic binders, damage-control surgery, and minimally invasive fixation techniques have enhanced patient survival and functional recovery. The integration of multidisciplinary trauma care and advanced interventional radiology further contributes to favorable outcomes.

Continuous refinement of diagnostic algorithms, surgical techniques, and trauma management protocols is essential for reducing complications and improving the quality of care for patients with combined pelvic injuries.

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