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ORIGINAL PAPER

Patient-related quality of life after pelvic ring fractures in elderly

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Abstract

Purpose Pelvic ring fractures, occurring in elderly patients are a challenging problem. Little known is about the patient-related outcome after these injuries. The primary objective of this study is to evaluate the quality of life after pelvic ring injuries in patients aged over 60 years.

Methods Patients (≥ 60 years) with pelvic ring fractures treated in our trauma department between 2004 and 2014 were included. Next to patient data, injury-related details as well as treatment details were assessed. After a follow-up of at least two years, the survival rate and the patient-related outcome were evaluated using the SF-36 and the EQ-5D score.

Results One hundred ninety-six patients (138 women; 58 men; mean age 75.3 ± 7.8 years) were identified. Ninety-six patients were treated operatively, 100 patients conservatively. The overall complication rate was significantly lower for conservatively compared to operatively treated patients (conservatively 18% vs. operatively 33%; $p = 0.014$). The total mortality rate over 2 years is 29% with no significant difference of the two-year survival rate (2-year survival rate: operatively 77% vs. non-operatively 65%; $p = 0.126$). Fifty-five patients completed the SF-36 and EQ-5D score after a mean follow-up of 4.2 ± 2.9 years. The mean physical component score of the SF-36 is 33.6 ± 8.3, and the mean mental component score is 45.3 ± 8.4. The mean EQ-5D VAS reached 62.5 ± 27.9.

Conclusion Elderly patients with pelvic ring fractures show a high mortality rate and a limited patient-related outcome. While the complication rate of conservatively treated patients is lower compared to operated patients, the two year survival rate is steady.

Keywords Pelvic ring fractures · Elderly patients · Patient-related outcome · SF-36 · EQ-5D

Introduction

Pelvic ring fractures in elderly patients are a challenging traumatological issue [1]. Next to fragility fractures of the proximal femur, humerus, distal radius, or vertebral bodies, the number of fractures of the pelvic ring in elderly patients is increasing [2, 3]. In contrast to pelvic ring fractures of younger patients, mainly caused by high-energy accidents, elderly patients can suffer these injuries due to a low-impact accident or in daily activity [4]. Pelvic ring fractures, occurring in elderly patients, are fundamentally different from those of younger patients and must be considered as a separate entity [5]. Therefore, special classification systems, like the comprehensive classification system of fragility fractures of the pelvic ring, published by Rommens et al. are increasingly used in clinical routine [5]. Next to traumatological specificities, an interdisciplinary team approach is important in order to achieve the best outcome [6]. Beside the radiological and functional outcome, the patient-related outcome after these injuries is important to choose the optimal treatment strategy for the individual elderly patient. Meanwhile, many data concerning the quality of life and mortality rate of typical fracture entities in elderly patients, such as proximal femur fractures are available [7–11]. Little is known about the quality of life after pelvic ring injuries [12, 13] and hardly anything about quality of live after pelvic ring fractures in the elderly. The primary aims of this investigation are to evaluate the mortality rate and the health-related outcome after pelvic ring injuries in patients aged over 60 years. In this context, possible differences of outcome between conservative and operative treatment strategies should be analyzed.

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Materials and methods

Patients over 60 years old with pelvic ring fractures treated in our trauma department (level 1 trauma centre) between January 2004 and December 2014 were included in this study. Patients younger than 60 years, with an associated acetabular fracture, and those who suffered from a malignant disease were excluded (Fig. 1). Next to the patient related data (sex, age), injury related details (ASA score (American Society of Anesthesiologists), injury mechanism, additional injuries, fracture type) as well as treatment details (conservative vs. operative treatment; hospitalization period, adverse events) were assessed. All fractures were classified based on plain X-rays and computer tomographic (CT) scans according the AO/OTA classification system [14]. In patients who do not have any trauma or suffered a low-energy impact trauma, the Rommens fragility fracture of the pelvic ring (FFP) classification system was additionally used [5]. Since this classification system was published in 2013, the FFP was classified retrospectively and individually by two authors (PS, SL).

According to fracture morphology and the assumed grade of instability, the way of treatment was chosen. Especially for critically ill patients as well as for those who had an assumed stable fracture but could not be mobilized under appropriate pain therapy and physical assistance, individual treatment decisions were made. Table 1 shows the performed various operative strategies (Fig. 2).

After follow-up, the survival rate and the patient-related outcome were evaluated using the SF-36 and the EQ-5D score.

This study was carried out in accordance with the Declaration of Helsinki and approved by the ethics committee at the University of Regensburg in July 2015 (Institutional Review Board Number 15-101-0091). Informed consent was obtained from all individual participants included in the study.

Quality of life (QoL) instruments

The patient-related outcome and quality of life were assessed using the German SF-36 [15] and EQ-5D [16] medical outcome scores.

SF-36 raw data transformation and summary score calculation were performed as described by Bullinger et al. [15]. Normative data from Germany, consisting of people over 60 years, were used as reference [17].

EQ-5D evaluation was performed using the VAS-EQ-5D method [18]. The results were compared with normative data from Germany, consisting of people over 60 years [19].

Patients were contacted by telephone to ensure that they agree on participating in the study. If patients were not reachable by phone, forms were sent to the last known address. The scores were posted to all patients at least 24 months after surgery.

Statistics

Statistical analysis was carried out using SPSS software (SPSS Inc., Chicago, IL).

The chi-square independence test was performed to compare categorical variables; and the independent *t* test was used to compare continuous variables after determining the distribution was appropriate for parametric testing. P values < 0.05 were considered significant.

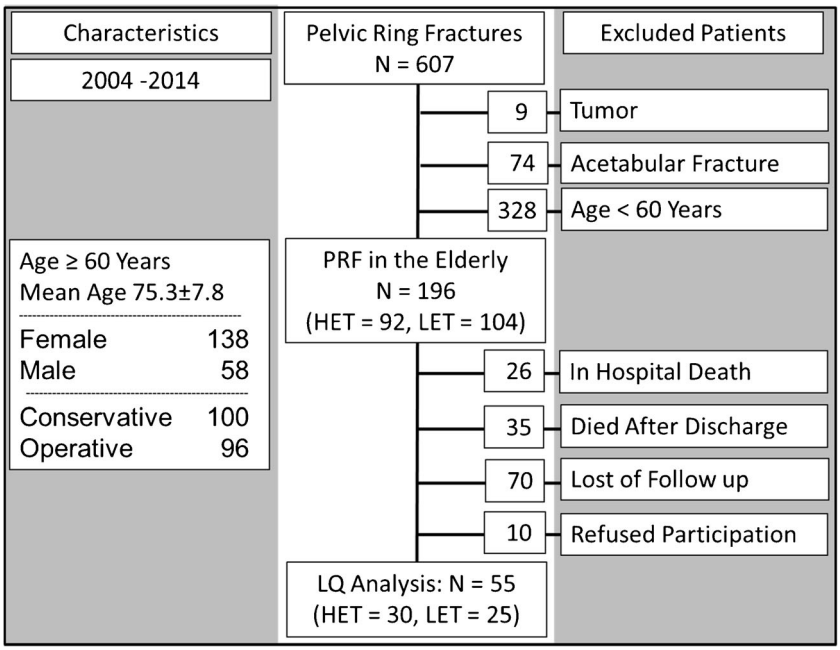

Fig. 1 Flowchart: Pelvic ring fracture (PRF), High-energy impact trauma (HET), Low-energy impact trauma (LET), Life quality (LQ)

Table 1 Therapeutic procedure. Detailed description of performed therapy and differences between low-energy impact and high-energy impact injuries

Therapy	Total ($N = 196$) % (N)	Low-energy impact injury ($N = 104$)	High-energy impact injury ($N = 92$)
Conservative	51% (100)	62% (65)*	38% (35)*
Operative	49% (96)	38% (39)*	62% (57)*
Ventral stabilization	95% (91)	97% (38)	93% (53)
Supraacetabular external fixation	52% (50)	23% (9)	72% (41)
Supraacetabular internal fixation	7% (7)	18% (7)	0% (0)
Plate osteosynthesis	18% (17)	26% (10)	12% (7)
Screw fixation	18% (17)	31% (12)	9% (5)
Dorsal stabilization	58% (56)	64% (25)	54% (31)
Iliolumbar fixation	6% (6)	15% (6)	0% (0)
Transiliac internal fixation	32% (31)	38% (15)	28% (16)
Iliosacral plate	9% (9)	3% (1)	14% (8)
Iliosacral screw	10% (10)	8% (3)	12% (7)

*p value < 0.001

Results

A total number of 196 patients (138 women; 58 men; mean age 75.3 ± 7.8 years, minimum 60 years, maximum 94 years) were identified. The mean ASA (American Society of Anesthesiologists) score was 3 ± 1 with no differences between operatively and conservatively treated patients (operative 3.1 ± 0.9; conservative 2.9 ± 1; $p = 0.156$).

Trauma mechanism and fracture classification

Ninety-two patients (47%) suffered a high-energy trauma, while in 104 patients (53%), no trauma or low-impact injuries could be found. Most of these patients were injured by a fall from standing position (Table 2). One hundred seventeen patients (60%) had additional injuries (head 26 (13%); spine 27 (14%); chest/abdominal 27 (14%); upper extremity 32 (16%);

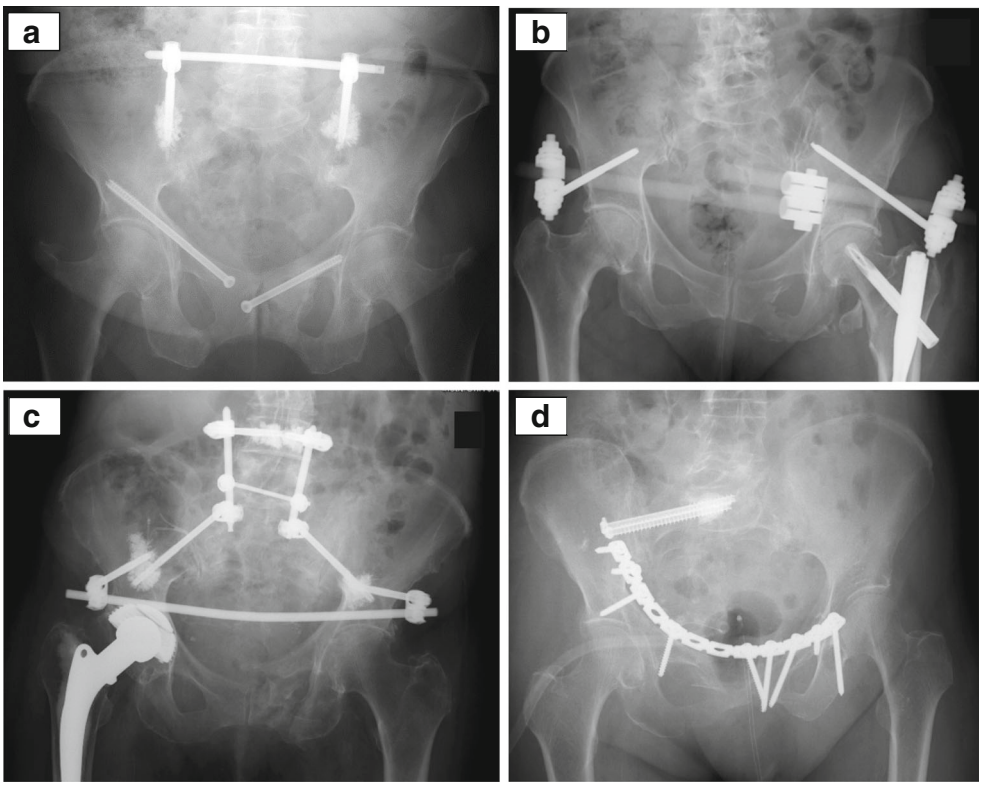

Fig. 2 Operative treatment options. **a** *Dorsal:* transiliac internal fixation; *ventral:* screw fixation. **b** Supraacetabular external fixation. **c** *Dorsal:* Iliolumbar fixation; *ventral:* supraacetabular internal fixation. **d** *Dorsal:* Iliosacral screw fixation; *ventral:* plate osteosynthesis

Table 2 Injury mechanism. Detailed information about injury mechanism. Distinction between low- and high-energy impact injury

	N (N_{total} = 196)	Percent
Low-energy impact injury	104	53%
No trauma	7	4%
Fall from standing position	89	45
Other low-energy impact injury	8	4%
High-energy impact injury	92	47%
Fall under 3 m	18	9%
Fall over 3 m	21	11%
Roll-over injury	11	6%
Other high-energy impact	42	21%

lower extremity 14 (7%)). Patients with high-energy impact traumas showed more frequent additional injuries ($p < 0.001$) (Table 3).

Within the entire collective, 51 patients (26%) had type A fractures, 67 patients (34%) had type B fractures, and 78 patients (40%) had type C fractures according to the AO/OTA classification system [14] (Fig. 3a). One hundred four patients showed fragility fractures of the pelvic ring and were classified according to the comprehensive classification system [5]. Thirty-one patients (30%) had FFP 1 fractures, 39 patients (38%) had FFP 2, 19 patients (18%) had FFP 3, and 15 patients (14%) had FFP 4 fractures (Fig. 3b).

Hospital stay

Treatment

Ninety-six patients (mean age 73.8 ± 7.2 years) were treated operatively, while 100 patients (mean age 76.8 ± 8.1 years) received conservative treatment ($p > 0.05$). Regarding operatively treated patients, 51 received ventral and dorsal osteosynthesis, 40 patients solely ventral, and five patients solely dorsal osteosynthesis (Table 1). Conservative treatment was carried out either with full weight-bearing (23 patients), partial load bearing with a maximum of 20 kg for six weeks (59 patients) or without any load on the injured side (18 patients).

Patients with low-energy impact injuries were treated more frequent conservatively ($p < 0.001$).

Hospitalization period

The mean hospital stay of the non-operative group was 12.7 + 8.2 days, which was significantly shorter ($p < 0.001$) than the operative group (23.6 + 17.2 days).

Adverse events and early mortality

Twenty-sixpatients (13.3%) died during hospital stay, 11 patients of the operative group (11.4%) and 15 patients (15.0%) of the conservative group. In the operative group, 32 patients (33.3%) were diagnosed with adverse events, including bleeding with the need of transfusion ($n = 15$), superficial or deep wound infection ($n = 8$), acute respiratory insufficiency ($n = 4$), acute heart failure ($n = 2$), mesenteric infarction ($n = 1$), multi-organ failure ($n = 2$), and implant loosening ($n = 4$). In 16 cases (16.7%), the adverse events were associated to the operative treatment/surgical procedure. Eighteen patients of the conservative group (18.0%) showed adverse events, including bleeding with the need of transfusion ($n = 4$), infection ($n = 3$), acute heart failure ($n = 4$), acute respiratory failure ($n = 3$), and multi-organ failure ($n = 6$). The overall rate of adverse events was significantly higher for the operative group compared to patients treated conservatively ($p = 0.014$).

Follow-up

Fifty-five patients (40 women, 15 men; mean age 77.9 ± 7 years) answered questionnaires with a mean follow-up of 4.2 ± 2.9 years (2–11). Within these patients, 36 were treated operatively and 19 patients conservatively. Twenty-five patients suffered a low-energy impact injury; in 30 patients, the pelvic ring fracture was caused by a high-energy impact injury. Sixty-one patients could not be included due to death. Ten patients declined participating questionnaires. Seventy patients (35.7%) (conservative group: $n = 35$; operative group: $n = 35$) could not be traced.

Two-year-survival

The two year survival rate did not show any significant difference between the operatively treated 77% (47/61) versus the non-operatively treated 64.6% (42/65) patients ($p = 0.126$). The overall two year mortality rate was 29.3% (37/126).

Table 3 Additional injuries. Differences between additional injuries of patients with low- and high-energy impact traumas

Additional injuries	Total ($N = 196$) % (N)	Low-energy impact injury ($N = 104$)	High-energy impact injury ($N = 92$)	p value
None	40% (79)	66% (69)	11% (10)	< 0.001
Additional injuries	60% (117)	34% (35)	89% (82)	

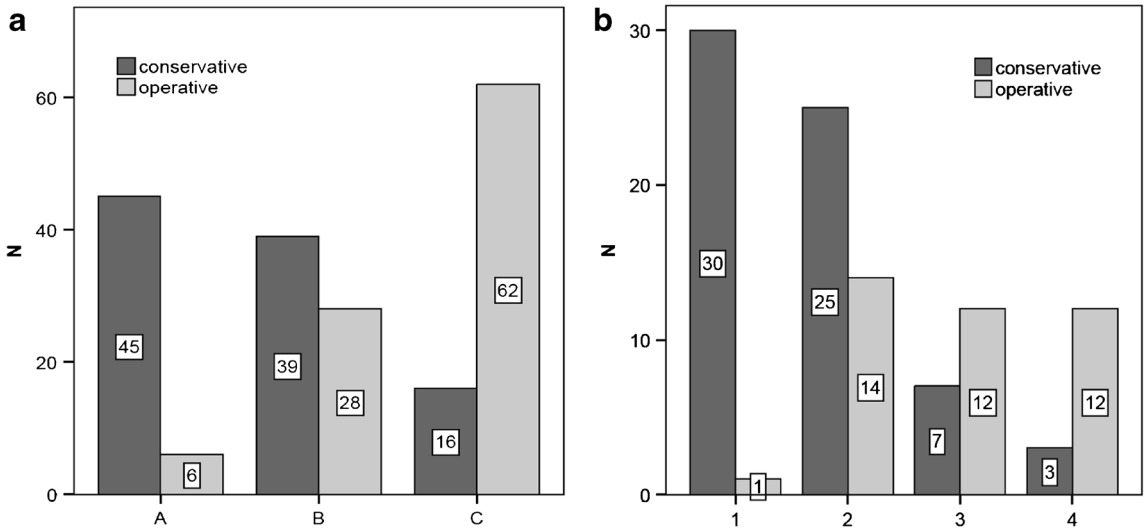

Fig. 3 Pelvic fracture classification. **a** AO/OTA fracture classification system [14]. **b** Comprehensive classification of fragility fractures (FFP) according to Rommens [5]

Quality of life

The mean EQ-5D VAS reached 63 ± 28, without significant differences between operatively and conservatively treated patients ($p = 0.379$) (Fig. 4a).

The mean physical health component score of the SF-36 was 34 ± 8, and the mean mental health component score was 45 ± 8. The physical health component score was significantly lower for the operative group than for conservatively treated patients ($p = 0.012$) (Fig. 4b). The mean mental health component score showed no significant differences between the two groups ($p = 0.153$) (Fig. 4c). Comparing patients with additional injuries and patients without, no significant difference for the EQ-5D or SF-36 were detected ($p > 0.05$).

The overall life quality scores (EQ-5D, SF-36) as well as the scores for the subgroups (operative and conservative) were significantly lower compared to an age-matched normal population without any injuries ($p < 0.05$) (Fig. 4a–c).

Discussion

This study deals with the post-traumatic quality of life, survival rate, and adverse events of elderly patients, who were suffering a pelvic ring fracture. The large patient cohort (196 patients) and the long-time follow-up (4.2 years) are outstanding characteristics of our study.

Especially in elderly patients, next to pelvic ring fractures due to high-energy trauma, another fracture entity can be detected: fragility fracture of the pelvis (FFP) [4, 5]. More than half of the patients included in our study suffered a low-energy impact injury, mostly a fall from standing position with a consecutive fragility fracture of the pelvis.

Even so, Rommens et al. proposed a new comprehensive classification system for fragility fracture of the pelvis [5] that gives good advices how to treat these fractures, the mortality rate as well as patient-related outcome scores have not yet been take into account to choose the optimal treatment strategy for the individual elderly patient. Whereas many data of mortality rate and post-traumatic quality of life concerning femoral neck fractures exist [9, 10, 20–22], these data are missing for fragility fractures of the pelvis.

An important finding of our investigation is the high rate and variety of adverse events as well as the high mortality found within the collective. The overall rate of adverse events is 26%, and the two year mortality rate is 29%. While in operatively treated patients, bleeding and infection were the most frequently diagnosed adverse event, non-operative treated patients show a high rate of medical complications like acute heart or lung failure. The 2-year survival rate shows no significant differences between operatively and conservatively treated patients. These results comply with the rare previous published data [1, 23–26]. Dijk et al. analyzed 99 patients, older than 60 years with isolated fractures of the pubic ramus. In 20% of these patients, adverse events, mainly caused by infectious diseases occurred. The one year mortality rate is 24.7% [24]. Similar results are published by Hoech et al. [1]. Within this study, 128 patients, older than 65 years, with lateral compression fractures of the pelvis were evaluated. They also found a high overall mortality (30%) and complication rate (conservative 8%; operative 18%) [1]. In contrast to our results, Höch et al. found a higher two year survival rate for patients treated operatively.

It is indispensable for clinical decision making not only taking into account potential complications, mortality, or survival but also of a potential increase of the quality of life for

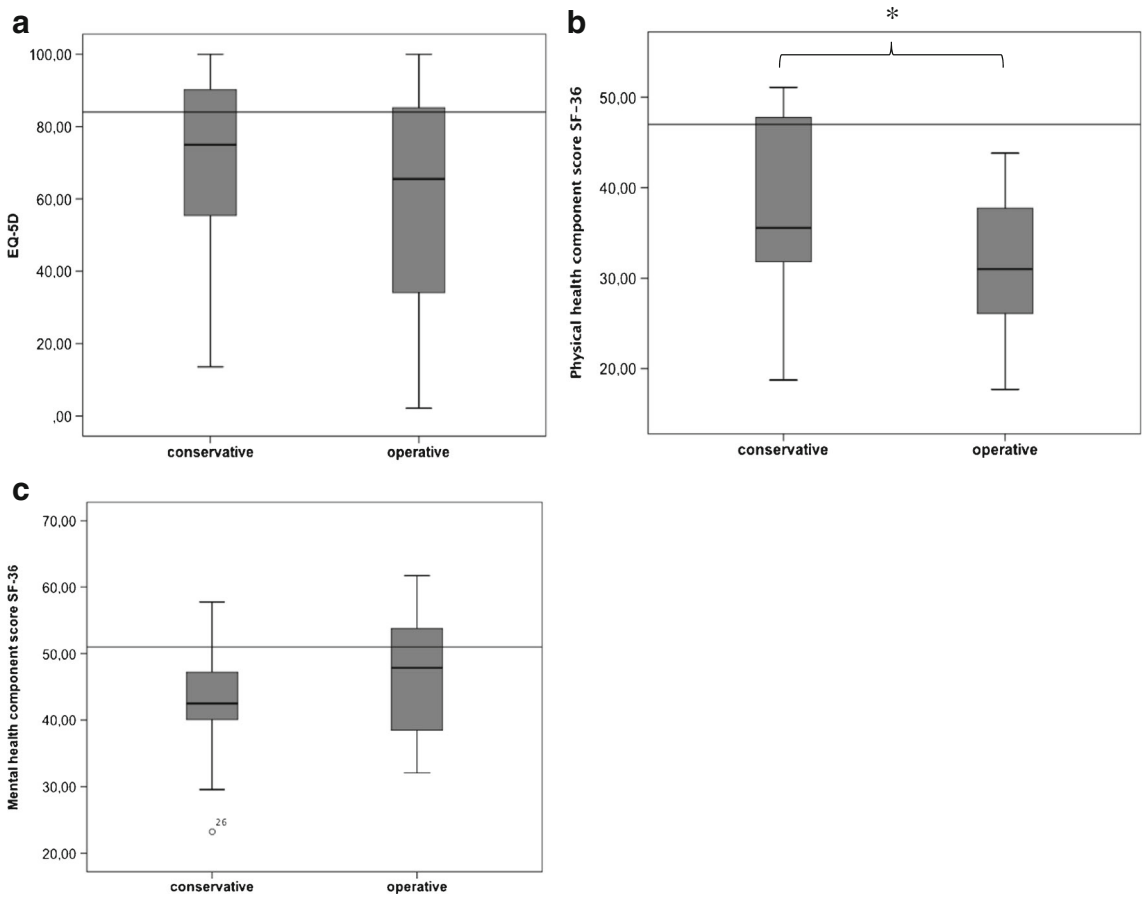

Fig. 4 Patient-related quality of life. **a** EQ-5D. **b** Physical health component score of SF-36 (PCS). **c** Mental health component score (MCS) of SF-36. Horizontal lines: mean score of age-matched normal population [17, 19]. *Significant difference

the patients [1, 27]. In our study, a lower patient-related quality of life compared to an age-matched reference population becomes obvious (Fig. 4). Oliver et al. and Van den Bosh et al. evaluated operatively treated patients, who suffered a pelvic ring fracture due to high-energy impact injury with a mean age of 33 years, respectively 35 years [27, 28]. In addition, the health-related quality of life in these patients was lower compared to a reference population but higher compared to ours.

Table 4 Summary of the investigated results

	Operative	Conservative	*p* value
ASA	=	=	$p = 0.156$
Hospitalization		Shorter	$p < 0.001$*
Adverse events	Higher		$p < 0.014$*
Two-year survival	=	=	$p = 0.126$
EQ-5D VAS	=	=	$p = 0.379$
SF 36 PCS	Less		$p < 0.012$*
SF 36 MCS	=	=	$p = 0.153$

p values ≤ 0.05 were considered significant

ASA American Society of Anesthesiologists, *VAS* visual analog scale, *SF-36 PCS* physical health component score, *SF-36 MCS* mental health component score

*Significant difference

Limitations of this study The low rate of response is one limitation of this study. The chosen scores (SF36, EQ-5D) are comprehensive scores evaluating diverse aspects responsible for live quality. Their complex structure might be responsible for the low rate of response. Another reason for the low follow-up rate might be the high mortality rate and age of the patients [1].

Another limitation of the study is that it is not possible to distinguish to what extend a lowered QoL is attributable to the pelvic ring fracture in multiple injured patients. Especially, patients with high-energy impact traumas have had more frequent additional injuries. To get further information concerning this problem, we analyzed patients with and without additional injuries and could not detect any significant differences of the health-related quality of life ($p > 0.05$). Furthermore, comparison of operatively and conservatively treated patients is possible only to a limited extend, because conservatively treated patients are facing less severe fractures compared to the operative group.

In conclusion, elderly patients after pelvic ring fractures have a high mortality rate and a lower patient-related quality of life compared to a reference population in this age group (Table 4). The two year survival rate is low and does not even increase after operative treatment and assumed early mobilization. The rate of adverse events associated to the injury and the general condition of the old patient as well as associated to the operative treatment is high. Nevertheless, in case of unstable pelvic ring fractures or unsatisfactory results of conservative treatment, an operative stabilization is inevitable to prevent immobilization.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

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