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Review Article

There have been changes in the incidence and epidemiology of pelvic ring fractures in recent decades?

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ABSTRACT

The pelvic ring fractures comprise 2–8% of all skeletal injuries. As the incidence rises to 25% in polytrauma and represents a negative prognostic factor with regard to morbidity and mortality of patients, we sought with this work to establish the profile of these, compared to an alteration in the profile of patients with pelvic ring fractures in recent decades. To this end, we evaluated the epidemiological profile, mechanism of injury and types of fractures. By reviewing the literature indexed in the databases related to the theme, 20 papers were selected that contained the requirements for the study. For the period between January 1987 and December 1999 (first decade), and another period in January 2000 and December 2010 (second decade), data were analyzed by Mann-Whitney test. The ratings Tile, Young and Burgess AO were adequate to permit their categorization. The research in each decade was homogeneous. At first the lesions were more prevalent in men with 62.5% with a tendency to reverse this pattern given the increase of women in the second decade ($p=0.286$). The average age in the first decade was 39.3 years, an increase in the second ($p=0.068$). The most prevalent mechanisms of trauma were related to traffic in both periods as well as fractures classified as type A ($p=0.203$ and $p=0.457$, respectively), having mortality rates decreased ($p=0.396$). We conclude that there was a tendency to increase in the average age of patients ($p=0.068$); however the increasing involvement of women ($p=0.286$) and decreased mortality ($p=0.396$) were not significant.

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Houve mudanças na incidência e na epidemiologia das fraturas do anel pélvico nas últimas décadas?

RESUMO

As fraturas do anel pélvico compõem de 2% a 8% de todas as lesões do esqueleto, incidência que sobe para 25% nos politraumatizados e representa fator prognóstico negativo no que

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Epidemiologia
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Metanálise

diz respeito à morbidade e à mortalidade. Buscou-se com este trabalho estabelecer se houve mudança do perfil desses pacientes nas últimas décadas e por que ela ocorreu. Para tanto, avaliaram-se epidemiologia, mecanismo de trauma e tipos de fratura, por revisão bibliográfica nas bases de dados indexadas relacionadas ao tema, selecionados 20 trabalhos que continham os requisitos para o estudo. O período entre janeiro de 1987 e dezembro de 1999 (primeira década) e outro de janeiro de 2000 a dezembro de 2010 (segunda década) foram analisados e comparados estatisticamente pelo Teste de Mann-Whitney. As classificações de Tile, Young Burgess e AO foram adequadas para permitir sua categorização. As pesquisas em cada uma das décadas foram homogêneas. Na primeira, as lesões foram mais prevalentes em homens, com 62,5%, com tendência a inversão desse padrão, dado o aumento de mulheres acometidas na segunda década ($p=0,286$). A média de idade na primeira década era de 39,3 anos e revelou um aumento na segunda ($p=0,068$). Os mecanismos de trauma mais prevalentes foram aqueles relacionados ao tráfego nos períodos, assim como as fraturas classificadas como do tipo A ($p=0,203$ e $p=0,457$, respectivamente). Os índices de mortalidade diminuíram ($p=0,396$). Conclui-se que houve tendência ao aumento na média de idade dos pacientes ($p=0,068$). Já o crescente acometimento das mulheres ($p=0,286$) e a diminuição da mortalidade ($p=0,396$) não foram significantes.

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Introduction

Trauma is a worldwide public health problem and it has been estimated that in traffic accidents alone, trauma is responsible for around 1.2 million deaths around the world.¹ It presents great morbidity that today affects more than 50 million people.² This situation is worse in urban centers, especially in capitals and metropolitan regions, where the growing vehicle fleet and greater aggressiveness in traffic cause high-energy accidents and consequently increase the number of deaths.^{3,4}

In the young and economically active population, the main cause of death is external agents. In comparison with other age groups, this population is seen to have a more audacious profile, which raises the rates of mortality due to accidents and urban violence.⁵⁻¹¹ Within this scenario, traffic accidents are among the main health hazards, and the risk factors for such accidents are young age group, male sex and low social level.¹² The severity of these accidents gives rise to long periods of hospitalization, with a demand for high-cost resources and consequently greater expenditure of public and private funds.¹²⁻¹⁶ In an attempt to minimize the catastrophic repercussions of traffic accidents on Brazilian public health, medical and governmental entities have been increasingly adopting preventive measures over recent years, with the aims of diminishing the absolute number of accidents and minimizing their consequences. Installation of medical rescue services on highways and also in Brazilian cities, from the 1980s onwards, is an example of this measures.¹⁷

Other well-known advances were the creation of the Brazilian National Traffic Code of 1998 (Law 9503 of September 23, 1997),¹⁸ which led to a reduction in the number of deaths, and also legislation of greater rigor, such as Law 11705 of June 19, 2008,¹⁹ popularly known as the "Dry Law", which showed a proportional decrease in the risk of death. These measures have been shown to be effective, although they still need improvement and updating, such as higher enforcement

levels and deepening of the educational process among the Brazilian population.²⁰

In parallel with the implementation of these laws that were created in an attempt to diminish the frequency of these accidents, the vehicle fleet has been increasing progressively. According to DENATRAN, the number of motor vehicles has increased by around 300% over the last ten years. In the municipality of São Paulo, the mortality rate among victims of vehicle accidents increased from 0.4/100,000 inhabitants to 1.4/100,000 inhabitants over the period from 1996 to 2005.²¹

Today, there is still a lack of detailed data regarding trauma severity, injuries most frequently observed, sequelae and complications specifically related to accidents involving vehicles around the world. Such information could help in implementing preventive measures and providing attendance for these patients, through directing physicians in their diagnostic investigations and in determining priorities.

With the aim of understanding the changes in behavior within society over recent decades, with regard to trauma mechanisms and consequently the types of pelvic ring fracture (Fig. 1A-D), the diagnosis, morbidity and mortality of pelvic fractures have been widely discussed by various medical societies, governments and the general population.¹⁷⁻¹⁹ Pelvic ring fractures account for 2-8% of all skeletal injuries, which increases to 25% among multiple trauma patients. Within this context, they represent a negative prognostic factor with regard to morbidity and mortality among multiple trauma patients. Thus, this situation stimulated us to establish the epidemiological profile of these fractures through reviewing the literature.²²

Objective

To compare whether there were any changes in the profile of patients with pelvic ring fractures between the 1990s and 2000s. For this, the epidemiological profile (age, sex and mortality), trauma mechanism and fracture types were evaluated.

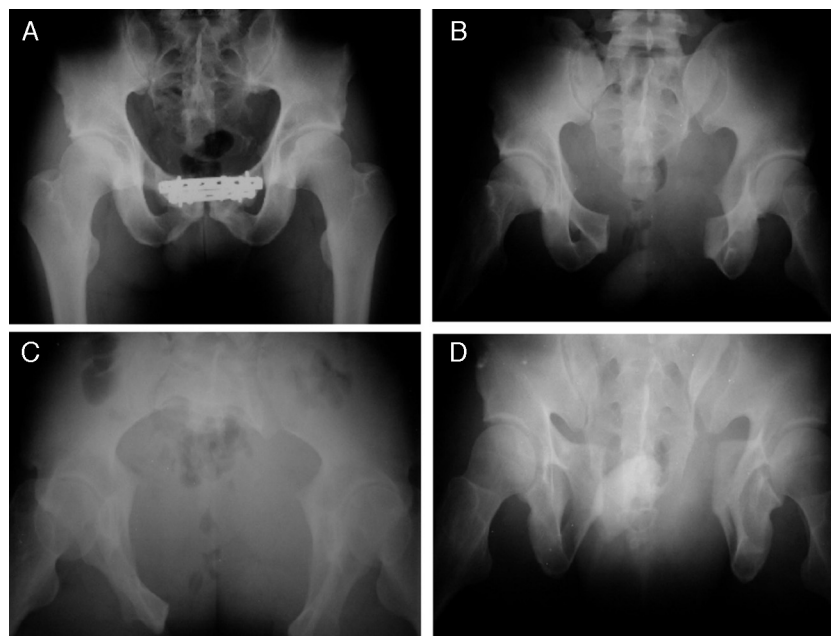


Fig. 1 – Radiographs of pelvic ring fracture. (A) Pelvis fracture of Tile type B, frontal radiograph. Image from the files of the Hip Group of DOT-ISCMS. (B) Pelvis fracture of Tile type B, inlet radiograph. Image from the files of the Hip Group of DOT-ISCMS. (C) Pelvis fracture of Tile type B, outlet radiograph. Image from the files of the Hip Group of DOT-ISCMS. (D) Pelvis fracture of Tile type B, postoperative radiograph. Image from the files of the Hip Group of DOT-ISCMS.

Material

After obtaining approval from the Research Ethics Committee of Irmandade de Misericórdia da Santa Casa de São Paulo (51/2012), a bibliographic review was conducted in the Medline, PubMed, Lilacs and Cochrane databases and literature relating to this topic over the last two decades, searching for descriptions of the epidemiology of pelvic ring fractures. These articles would need to present some of the following keywords in their content: fractures, pelvic ring; epidemiology; pelvic bones, injuries; fractures, bone/epidemiology; accidents, traffic; prospective studies; and retrospective studies. The data were gathered between December 2011 and March 2012.

The articles were selected after critical assessment of the strength of evidence and were only accepted if the impact was a minimum of 2A. Articles in which, despite their appearance in the search results, the methodology did not include complete evaluation of data based on age, sex, trauma mechanism, mortality and fracture type (refinement criteria) were discarded.

In evaluating the fracture types, we compared the Tile, Young-Burgess and AO classifications. We classified fractures as type A if they were Tile type A and AO type A; type B if they were Tile type B, Young-Burgess groups A and B and AO type B; and type C if they were Tile type C, Young-Burgess group C and AO type C.²³

The search located 152 articles, of which 73 met the refinement criteria. From these, texts that appeared in duplicate (total of 52 articles) were excluded. After reading the totals and abstracts, 20 studies that contained the data needed for this study were selected (Tables 1 and 2).

Method

These articles were divided into two periods: between January 1987 and December 1999 (named the first decade); and between January 2000 and December 2010 (named the second decade). The data were analyzed statistically using the Mann-Whitney test.

For this study, the significance level was defined as 0.05 (5%), and confidence intervals were constructed over the length of the study, with 95% statistical confidence (Table 3).

In this statistical analysis, the following software was used: SPSS V17, Minitab 16 and Excel Office 2010.

Results

Basically, we can say (with the exception of the number of patients) that study groups in each decade presented low variability regarding the refinement criteria, since the coefficients of variance were lower than 50% and demonstrated that the studies in each of the decades were homogenous (Table 3 and Fig. 2).

In the first decade, pelvic ring injuries were more prevalent among men (62.5%) than among women (37.5%). However, in the second decade, a greater proportion of women were affected (43.3%), although without expressing a significant difference ($p=0.286$).

The mean age in the first decade was 39.3 years, with a tendency toward increased mean age, of up to seven years, in the second decade ($p=0.068$).

Regarding the trauma mechanisms for the pelvic ring fractures, the most prevalent types were those relating to traffic:

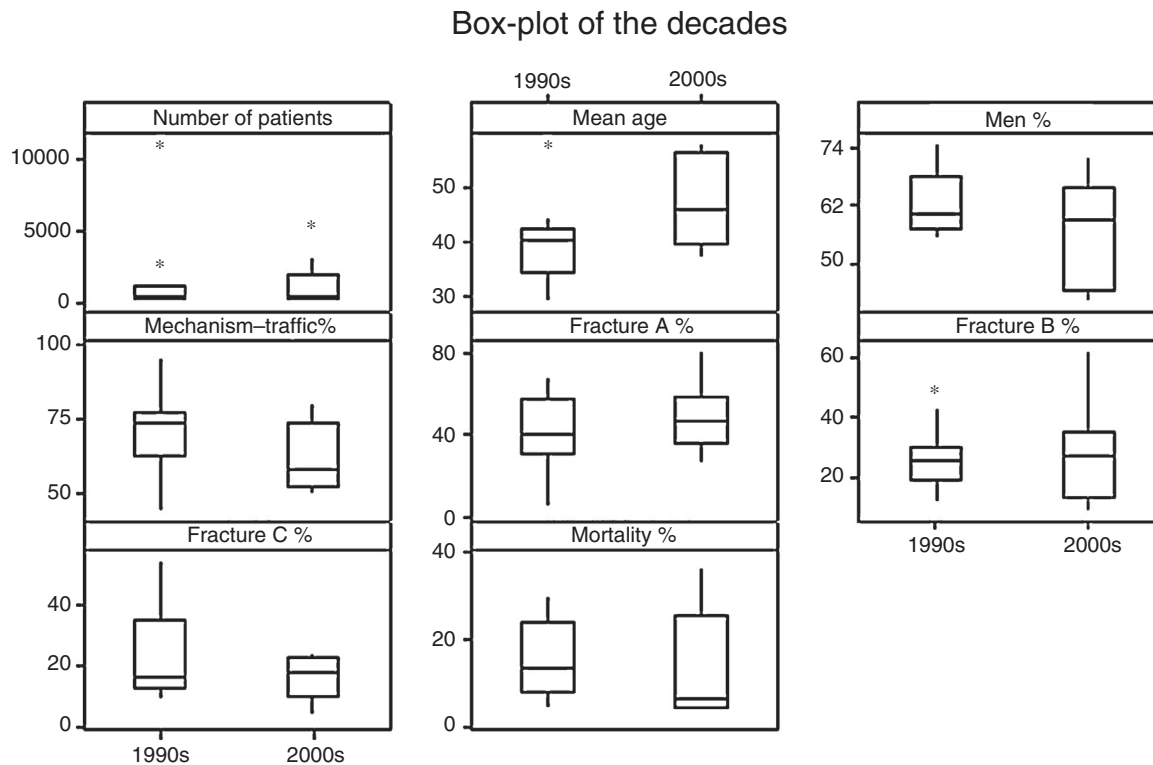


Fig. 2 – Box-plot of the decades, for all variables.

vehicle accidents, motorcycle accidents and being run over. This predominance was maintained throughout the period, with 70.7% and 62.7%, respectively ($p=0.203$), and was therefore not shown to be significant data.

We also found that most of the fractures were classified as type A (40.5%), followed by type B (26.7%) and type C (23.5%) in the first decade. There were slight increases in the types A and B injuries (48.6% and 28%) in the second decade, but these findings did not have statistical validity ($p=0.457$ and $p=0.967$, respectively).

The mortality rate was 15.1% in the first decade and this decreased to 13.6% in the second decade. This difference was not found to be significant, after analysis ($p=0.396$).

Discussion

With regard to attendance for multiple trauma victims in this city, we have noted changes in the epidemiological pattern of pelvic ring fractures in patients treated at our service over recent years. This has given rise to the need for us to investigate whether such changes have also been noted in the specialized literature.

We studied 20 articles that covered the period from 1995 to 2012, respecting the criteria enumerated earlier. Through ATLS and public health measures that were implemented at the beginning of the 1980s, multiple trauma patients have become better understood, with care developed, implemented and systematized over the last 20 years. By focusing on this period, we sought to investigate the epidemiological profile of pelvic ring injuries.²²

A tendency toward inversion of the proportions regarding the gender most affected with pelvic ring fractures, given that the present review found that females became more affected in the last decade, although this increase was not significant ($p=0.286$). This situation may be related to women's consolidation in the workplace and within social structures, which is increasingly active and economically participative, thus leading to greater exposure to traumatic events.

The aging of the population, with increasing life expectancy worldwide, is leading to a need for effective participation in day-to-day activities among individuals over the age of 60 years, who nowadays seem to be more independent and self-sufficient. The improved ability to access appropriate healthcare services, which formerly did not provide adequate or timely care for survival within this age group, and optimization of attendance for multiple trauma victims, corroborate the findings of increased mean age for pelvic ring injuries, comparing the two periods), which expressed a statistical tendency after analysis ($p=0.068$).

In the studies evaluated here, the trauma was predominantly due to vehicle traffic-related accidents, in both periods, even though this finding did not have validation ($p=0.203$). On the other hand, there was no stratification among the different possibilities for this type of event, such as: being run over, motorcycle accidents or car accidents. This gives rise to a certain amount of frustration, given that in making an analysis on the data, it was not possible to make inferences regarding which vectors were more prevalent.

Thus, we draw attention to the need to carry out trials that might define the trauma mechanism implicated in pelvic ring fractures, with the envisaged aim of not only

Table 1 – Studies analyzed in the first decade.

	Reference
(1)	Brenneman FD, Katyal D, Boulanger BR, Tile M, Redelmeier DA. Long-term outcomes in open pelvic fractures. Source Department of Surgery, Sunnybrook Health Science Center, University of Toronto, Ontario, Canada. <i>J Trauma</i> . 1997 May;42(5):773-7.
(2)	Lindsey M, Kohl RW 3rd. Pelvic fracture among polytrauma decedents: trauma-based mortality with pelvic fracture – a case series of 74 patients. The Ben Taub General Hospital, Baylor College of Medicine, Houston, Texas, USA. <i>Arch Orthop Trauma Surg</i> . 2001;121(1-2):43-9.
(3)	Grotz MRW, Allami MK, Harwood P, Pape HC, Krettek C, Giannoudis PV. Open pelvic fractures: epidemiology, current concepts of management and outcome. <i>Injury</i> . 2005; 36(1):1-13.
(4)	Chong KH, DeCoster T, Osler T, Robinson B. Pelvic fractures and mortality. <i>Iowa Orthop J</i> . 1997;17:110-4.
(5)	Gurevitz S, Bender B, Tytiun Y, Velkes S, Salai M, Stein M. The role of pelvic fractures in the course of treatment and outcome of trauma patients. <i>Isr Med Assoc J</i> . 2005;7(10):623-6.
(6)	Barzilay Y, Liebergall M, Safran O, Khoury A, Mosheiff R. Pelvic fractures in a level I trauma center: a test case for the efficacy of the evolving trauma system in Israel. <i>Isr Med Assoc J</i> . 2005 Oct;7(10):619-22.
(7)	Giannoudis PV, Grotz MR, Tzioupis C, Dinopoulos H, Wells GE, Bouamra O, Lecky FJ. Prevalence of pelvic fractures, associated injuries, and mortality: the United Kingdom perspective. <i>Trauma</i> . 2007;63(4):875-83.
(8)	Gänsslen A, Pohlemann T, Paul C, Lobenhoffer P, Tschorne H. Epidemiology of pelvic ring injuries. <i>Injury</i> . 1996;27 Suppl. 1:S-A13-20.
(9)	Schmal H, Markmiller M, Mehlhorn AT, Sudkamp NP. Epidemiology and outcome of complex pelvic injury. <i>Acta Orthop Belg</i> . 2005;71(1):41-7.
(10)	Pohlemann T, Tschorne H, Baumgärtel F, Egbers HJ, Euler E, Maurer F, Fell M, Mayr E, Quirini WW, Schlickewei W, Weinberg A. Unfallchirurg. Pelvic fractures: epidemiology, therapy and long-term outcome. Overview of the multicenter study of the Pelvis Study Group. 1996;99(3):160-7 [German]
(11)	Parreira JG, Haddad L, Rasslan S. Abdominal injuries in patients sustaining pelvic fractures. <i>Rev Col Bras Cir</i> . 2002;29(3):mai/jun.

conducting clinical studies on this topic but also making correlations between the mechanisms and the fracture classification, severity, evolution, complications and prognosis. The relevance of these data lies in their ability to help implement preventive public health measures, particularly with regard to traffic education and the need for referral and specialization centers for treating injuries of this type.

Type A fractures were the most prevalent type during both of the periods analyzed, which may be explained by accepting that this type of injury does not progress to death, thus making it possible for all cases with this diagnosis to be included in the databases ($p=0.457$). There was an increase in the numbers of fractures classified as B ($p=0.967$), comparing the decades

Table 2 – Studies analyzed in the second decade.

	Reference
(1)	Holstein JH, Culemann U, Pohlemann T. What are predictors of mortality in patients with pelvic fractures? Symposium: Disruptions of the Pelvic Ring: An Update. <i>Clin Orthop Relat Res</i> . 2012;470:2090-2097(8).
(2)	Ooi CK, Goh HK, Tay SY. Patients with pelvic fracture: what factors are associated with mortality? <i>Int J Emerg Med</i> . 2010;3(4):299-304.
(3)	Tosounidis G, Holstein JH, Culemann U, Holmenschlager F, Stuby F, Pohlemann T. Changes in epidemiology and treatment of pelvic ring fractures in Germany: an analysis on data of German Pelvic Multicenter Study Groups I and III (DGU/AO). <i>Acta Chir Orthop Traumatol Cech</i> . 2010;77(6):450-6.
(4)	Sharma OP, Oswanski MF, Rabbi J, Georgiadis GM, Lauer SK, Stombaugh HA. Pelvic fracture risk assessment on admission. <i>Am Surg</i> . 2008;74(8):761-6.
(5)	Chien LC, Cheng HM, Tsai MC. Pelvic fracture and risk factors for mortality A population based. <i>Eur J Trauma Emerg Surg</i> ; 2010;2:131-138.
(6)	Ježek M, Džupa V. The influence of patient age and mechanism of injury on the type of pelvic fracture: epidemiological study. <i>Acta Chir Orthop Traumatol Cech</i> . 2012;79(1):65-8.
(7)	Cordts RMF, Parreira JG, Perlingerio, JAG, Soldá SC, de Campos T, Asséf JC. Pelvic fractures as a marker of injury severity in trauma patients. <i>Rev Col Bras Cir</i> 2011;38(5):310-315.
(8)	Siegmeth A, Müllner T, Kukla C, Vécsei V. Associated injuries in severe pelvic trauma. <i>Unfallchirurg</i> . 2000;103(7):572-81.
(9)	Chueirel AG, Filho GC, dos Santos AFI, Pockell KP. Fraturas do anel pélvico: estudo epidemiológico. <i>Acta Ortop. Bras</i> . 2004;12(1), São Paulo, Jan./Mar.

analyzed. This result was expected because of the improvement of pre-hospital care, which ensured these patients' survival by improving their arrival at the emergency service. With attendance at the hospital that was more appropriate and increased admission of these patients, the number of patients treated increased. However, these results were not statistically significant over the period analyzed.

Despite the slight decrease in the mortality rate over the last decade ($p=0.396$), it can be inferred that even without statistical significance, and despite policies for accident prevention, attendance logistics and initial management of multiple trauma patients, and with structural improvements to vehicles and public highways, humans continue to seek to surmount limits, thus often insisting on risking their own lives, and the lives of others. This results in severe and often fatal accidents.

There are some limitations to the present study. The lack of standardization regarding trauma mechanisms and fracture classification in the studies evaluated gave rise to some difficulties, in addition to the lack of statistical significance of the data found, despite the n used, which was translated by the homogeneity of the sample. Use of studies written in English, Portuguese and Spanish may have affected the final result obtained. Future studies similar to this should take this into consideration.

Table 3 – Comparison of the variables analyzed.

Decades		Mean	Median	Standard deviation	CV	Q1	Q3	Min	Max	N	CI	p-Value
Number of patients	1990s	1.428	284	3.143	220%	77	875	39	11.149	12	1.779	0.776
	2000s	1.141	337	1.826	160%	179	566	43	5.340	9	1.193	
Mean age	1990s	39.3	40.0	7.8	20%	35.0	41.2	29.0	58.0	11	4.6	0.068
	2000s	46.8	45.6	8.2	18%	39.8	52.8	37.0	58.0	8	5.7	
Men %	1990s	62.5	60.1	6.6	11%	57.5	66.2	55.0	75.0	12	3.7	0.286
	2000s	55.7	59.0	11.1	20%	45.0	64.0	42.0	72.1	9	7.3	
Mechanism – traffic %	1990s	70.7	73.0	13.6	19%	63.8	76.2	44.0	95.5	10	8.5	0.203
	2000s	62.7	58.0	11.6	18%	53.9	71.4	50.0	80.0	7	8.6	
Fracture A %	1990s	40.5	40.6	19.9	49%	30.4	55.9	5.0	68.0	11	11.8	0.457
	2000s	48.6	46.4	17.1	35%	38.7	56.3	25.7	81.0	8	11.9	
Fracture B %	1990s	26.7	25.0	10.9	41%	20.0	28.5	11.6	49.0	11	6.4	0.967
	2000s	28.0	26.7	17.1	61%	17.6	34.4	8.7	62.3	8	11.8	
Fracture C %	1990s	23.5	16.0	15.0	64%	13.3	30.7	9.0	55.0	11	8.8	0.433
	2000s	16.2	17.5	7.3	45%	11.4	22.3	3.8	24.0	8	5.1	
Mortality %	1990s	15.1	13.5	8.6	57%	9.7	22.8	4.3	30.0	12	4.8	0.396
	2000s	13.6	6.5	12.7	94%	4.8	20.5	3.8	37.0	8	8.8	

CV, coefficient of variance; Q1, 1st quartile distribution of up to 25% of the sample; Q3, 3rd quartile, distribution of up to 75% of the sample; CI, confidence interval; p-value, result from each comparison.

Conclusion

We observed that the epidemiological profile of the pelvic ring fractures in the two decades did not present any significant changes. The growing trend for women to be more affected, the increase in the mean age, and the decrease in mortality over the period analyzed were the findings observed in our study, but without statistical significance.

Conflicts of interest

The authors declare no conflicts of interest.

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