Evaluation of Interobserver Agreement in the Diagnosis of Posterior Pelvic Ring Lesions Using Plain Radiography*

Avaliação da concordância interobservador no diagnóstico de lesões do anel pélvico posterior usando radiografia simples

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Abstract

Objective To evaluate the interobserver agreement of a radiologist, two hip specialist orthopedists with experience in the treatment of pelvic and acetabulum fractures, two general orthopedists, two orthopedics residents and two radiology residents regarding the diagnosis of posterior pelvic ring injuries using plain radiography.

Method A cross-sectional study conducted in September 2017. The exams of 20 patients who had been treated for traumatic lesions of the posterior pelvic ring were randomly selected.. A total of nine examiners from different medical fields evaluated the plain pelvic radiographs; those were compared with computed tomography, scans, which are considered a confirmatory diagnostic criterion. Interobserver agreement was assessed using the Kappa test (κ) and 95% confidence intervals (95%CIs).

Results A total of 28 lesions were found by computed tomography (23%; 95%CI: 16–32%) among all of the cases evaluated. The interobserver agreement between plain radiography and computed tomography was moderate among physicians with more experience: a radiologist ($\kappa = 0.461$; 95%CI: 0.270–0.652), hip specialists 1 and 2 ($\kappa = 0.534$; 95%CI: 0.348–0.721 and $\kappa = 0.431$; 95%CI: 0.235–0.627 respectively), and general orthopedists 1 and 2 ($\kappa = 0.497$; 95%CI: 0.307–0.686 and $\kappa = 0.449$; 95%CI: 0.254–0.645 respectively). Among the orthopedics and radiology residents, the interobserver agreement was considered poor. High false negative values were found among all of the examiners, especially regarding posterior iliac fractures and sacrum fractures.

Keywords
- medical education
- bone fractures
- radiology
- traumatology

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Conclusion Professionals with greater experience in the field have a better ability to identify posterior pelvic ring lesions by plain radiography, but we emphasize that plain pelvic radiography was susceptible to false negative evaluations among all of the professionals assessed.

Resumo

Objetivo Avaliar a concordância interobservador de radiologista, dois ortopedistas especialistas em quadril com experiência no tratamento de fraturas da pelve e acetábulo, dois ortopedistas gerais, dois residentes de ortopedia, e dois residentes de radiologia no diagnóstico de lesões do anel pélvico posterior usando radiografia simples.

Método Estudo transversal, realizado em setembro de 2017. Foram selecionados retrospectivamente e de modo aleatório exames de 20 pacientes atendidos previamente com lesões traumáticas do anel pélvico posterior. Nove examinadores de diferentes áreas médicas avaliaram as radiografias simples de bacia, que foram comparadas com a tomografia computadorizada, considerada critério confirmatório de diagnóstico. A concordância interobservador foi analisada pelo teste de Kappa (κ), e com intervalos de confiança de 95% (IC95%).

Resultados Foram encontradas pela tomografia computadorizada 28 lesões (23%; IC95%: 16–32%) em todos os casos avaliados. A concordância interobservador entre a radiografia simples e a tomografia computadorizada foi moderada nos médicos com mais experiência: o radiologista ($\kappa = 0{,}461$; IC95%: 0,270–0,652), os especialistas em quadril 1 e 2 ($\kappa = 0{,}534$; IC95%: 0,348–0,721; e $\kappa = 0{,}431$; IC95%: 0,235–0,627, respectivamente), e os ortopedistas gerais 1 e 2 ($\kappa = 0{,}497$; IC95%: 0,307–0,686; e $\kappa = 0{,}449$; IC95%: 0,254–0,645, respectivamente). Já com relação aos residentes de ortopedia e radiologia, a concordância interobservador foi considerada fraca. Nos diagnósticos de todos os examinadores, foram encontrados altos valores falso-negativos, principalmente nas fraturas da região posterior do ilíaco e nas fraturas do sacro.

Conclusão Profissionais com mais experiência na área apresentam melhor capacidade de identificação de lesões do anel pélvico posterior por radiografia simples; porém, salienta-se que a radiografia simples de pelve esteve suscetível a avaliações falso-negativas da parte de todos os profissionais estudados.

Palavras-chave
- educação médica
- fraturas ósseas
- radiologia
- traumatologia

Introduction

Plain radiographic assessment of the pelvis remains the initial diagnostic pillar for pelvic ring fractures, and it is recommended by the Advanced Trauma Life Support (ATLS), which was developed by the American College of Surgeons (ACS) Committee on Trauma (COT). However, injuries to the structures of the posterior pelvic ring (posterior portion of the iliac bone, sacroiliac joint and sacrum) are difficult to diagnose, and may cause delay and failure in the treatment of these lesions.[1]

Professionals with longer experience are considered to have a greater ability to diagnose posterior pelvic ring lesions by plain radiography.[2] However, studies show a high frequency of misdiagnosis with the use of plain radiography, especially in lesions involving the posterior pelvic ring structures, and they deem an imperative the performance of computed tomography (CT) scans, which are considered the gold standard in the diagnosis of these lesions.[3] To this end, the aim of the present study was to evaluate the interobserver agreement of a radiologist, hip specialist orthopedists, general orthopedists, orthopedics residents and radiology residents regarding the diagnosis of posterior pelvic ring injuries using plain radiography.

Materials and Method

A cross-sectional study conducted in September 2017 at the Orthopedics and Traumatology Service of Hospital Cristo Redentor (HCR) – Grupo Hospitalar Conceição (GHC), in the city of Porto Alegre, Southern Brazil. The research was approved by our institution's Ethics in Research Committee (under CAAE: 72595617.7.0000.5530). Retrospective examinations of 20 patients with traumatic injuries of the posterior pelvic ring previously treated in the emergency unit were randomly selected by lot. Only cases with simultaneous plain radiographic evaluation of the anteroposterior (AP) view of the pelvis and with CT scans were included in the study; the CT scans were used as confirmatory diagnostic criteria.

Examiners and image evaluation

The nine examiners were physicians, among them a radiologist with at least ten years of experience in trauma emergency, two

orthopedic specialists in hip surgery with at least ten years of professional experience and with experience in pelvic and acetabulum fracture surgery, two general orthopedists, two orthopedics residents, and two radiology residents, all with experience in emergency care.

The images were evaluated as follows: a) a room reserved for slide projections was allocated to the nine examiners; b) a chart with the pelvis design was presented, enabling the examiner to mark the lesion sites in the posterior pelvic ring regions: posterior iliac, sacroiliac joint and sacrum (►**Figure 1**) for each case presented, as well as for the absence of injury, if they so deemed it. In the present study, 120 anatomical sites were evaluated by each examiner; c) the radiographs of the selected cases were presented to the examiners through slide projections, with 30 seconds to consider each case. All of the selected cases presented an identifiable anterior pelvic ring lesion on the radiographs.

Data analysis

The data regarding the categorical variables were presented by frequency (%). Interobserver agreement was assessed by the Kappa test (κ) and 95% confidence intervals (95%CIs), and the values assumed for agreement were considered as follows: 0.20: poor; 0.21–0.40: fair; 0.41–0.60: moderate; 0.61–0.80: good; 0.81–1.00: very good.[4–6] The CT diagnosis was assumed as a reference evaluation. All analyses were performed using the Statistical Package for the Social Sciences (SPSS, IBM Corp., Armonk, NY, US), version 22.0 for Windows.

Results

A total of 28 lesions in the posterior pelvic ring were determined by CT from a total of 120 possible injuries (23%; 95%CI: 16%–32%), since our schematic chart enabled the identification of 6 lesion sites for each of the 20 cases. ►**Table 1** shows the interobserver agreement between the CT and the plain radiographic evaluation. Among the most experienced examiners, the agreement was moderate: radiologist ($\kappa = 0.461$; 95%CI: 0.270–0.652), hip specialists 1 and 2 ($\kappa = 0.534$; 95%CI: 0.348–0.721 and $\kappa = 0.431$; 95%CI: 0.235–0.627 respectively), and general orthopedists 1 and 2 ($\kappa = 0.497$; 95%CI: 0.307–0.686 and $\kappa = 0.449$; 95%CI: 0.254–0.645 respectively).When comparing the CT results with the diagnoses made by the orthopedics and radiology residents, the interobserver agreement was considered poor (►**Table 1**).

High false negative values were found in the diagnoses of all of the examiners: radiologist (46%), hip specialists 1 and 2 (46% and 54% respectively), general orthopedists 1 and 2 (46% and 54% respectively), orthopedics residents 1 and 2 (57% and 61% respectively) and radiology residents 1 and 2 (57% and 57% respectively).

►**Figure 2** shows the 28 lesions according to their respective anatomical sites: 3 posterior iliac fractures, 10 sacroiliac joint injuries and 15 sacral fractures were found on the CT. ►**Figure 3** shows the lesions found at each anatomical site in relation to the respective examiners.

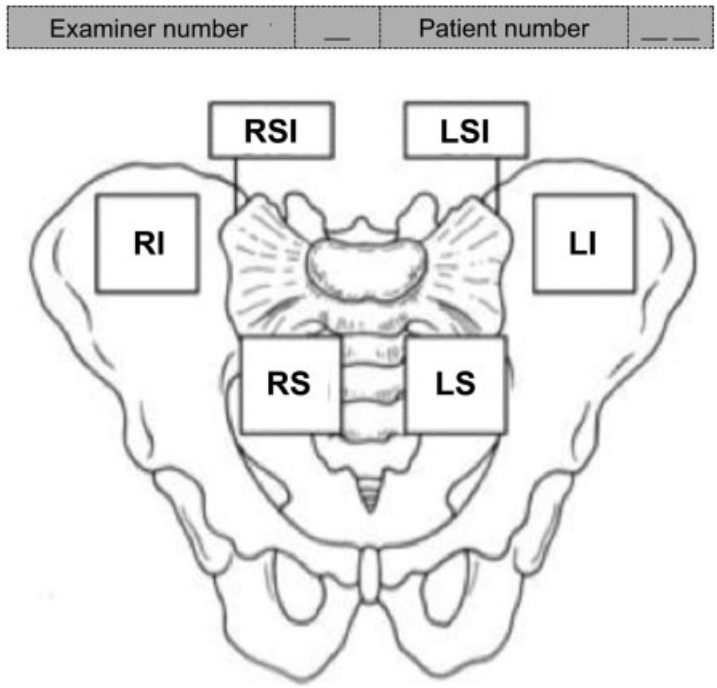

Fig. 1 Pelvic drawing sheet for the evaluation of injury sites in the regions of the posterior pelvic ring.

Table 1 Interobserver agreement of the diagnoses (by plain radiography) of lesions in the regions of the posterior pelvic ring, compared to the CT scans

Parameters	Lesion diagnosis		CT agreement	
	Negative	Positive	%	Kappa (95%CI)
CT (reference)	092 (77)	028 (23)		
Radiologist	196 (80)	024 (20)	82	0.461 (0.270–0.652)
Hip specialist 1	100 (83)	020 (17)	85	0.534 (0.348–0.721)
Hip specialist 2	100 (83)	020 (17)	82	0.431 (0.235–0.627)
General orthopedist 1	198 (82)	022 (18)	83	0.497 (0.307–0.686)
General orthopedist 2	101 (84)	019 (16)	82	0.449 (0.254–0.645)
Orthopedics resident 1	101 (84)	019 (16)	81	0.397 (0.198–0.596)
Orthopedics resident 2	101 (84)	019 (16)	79	0.344 (0.143–0.545)
Radiology resident 1	198 (82)	022 (18)	78	0.346 (0.146–0.545)
Radiology resident 2	198 (81)	022 (19)	77	0.329 (0.130–0.529)

Abbreviations: 95%CI, 95% confidence interval; CT, computed tomography.
Note: Data presented as frequency (%).

Discussion

In the present study, we identified that experienced professionals have a greater ability to diagnose posterior pelvic ring lesions by plain radiography. However, plain radiography was susceptible to a high percentage of false negative evaluations among all of the examiners when compared to the CT scans, that is, there was great difficulty in identifying posterior iliac and sacrum fractures.

Posterior pelvic ring injuries are severe and difficult to diagnose,[7–10] often requiring urgent stabilization to reestablish the polytraumatized patient from the hemodynamic point of view,[11–14] and/or subsequent surgical procedures to fix fractures or dislocations, enabling the patient to return to his or her best functional condition.

Pelvic radiography is indicated as one of the routine exams in high-energy trauma care, but in some situations this exam is insufficient for the diagnosis, classification and procedure definition.[15–19] The factors that make pelvic assessment difficult through isolated plain radiography are the lack of patient preparation, with the presence of artifacts such as gas, fecal content, bladder distension, and the complex three-dimensional conformation of the pelvis.[20,21] Due to the angle of inclination of the sacrum, visualization is limited in the pelvis AP.[1]

The CT is often not available in non-specialized centers,[8,22–24] and with it the patient is subjected to a higher radiation dose. Publications have shown a high frequency of failure to diagnose pelvic lesions on radiographs, especially lesions involving the sacroiliac joint and the sacrum.[25,26] The identification of up to 30% of sacrum fractures is late, which has a negative effect on long-term outcomes.[3,27,28] Montana et al[29] found diagnosis failure in 28% of sacroiliac joint dislocations, and in 57% of iliac and sacral fractures adjacent to the sacroiliac joint, with the isolated use of plain radiography.

The present study has some limitations: a) the inferior quality of some of the selected radiographs, a usual occurrence in the emergency care context; and b) the definition of the number of selected cases, as well as of the examiners, was performed through a convenience sample.

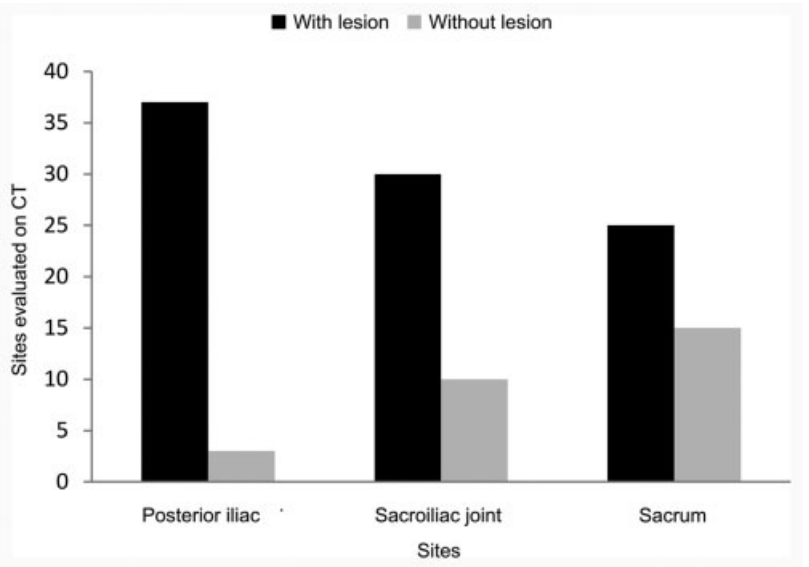

Fig. 2 Sites evaluated on computed tomography (CT) of the regions of the posterior pelvic ring (posterior iliac, sacroiliac joint and sacrum) with or without lesions.

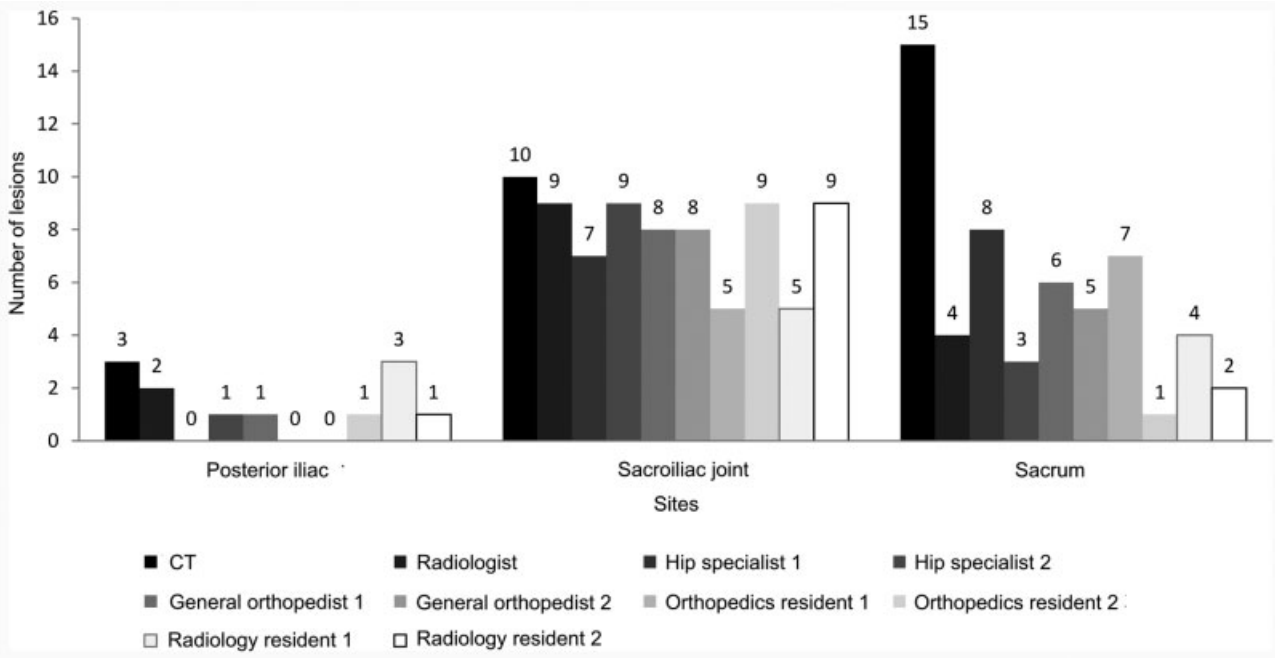

Fig. 3 Number of posterior pelvic ring lesions by site and examiner.

Conclusion

Professionals with greater experience in the field have a better ability to identify posterior pelvic ring lesions by plain radiography; however, we emphasize that simple pelvic radiography was susceptible to false negative diagnoses among all of the professionals assessed, especially regarding fractures of the posterior region of the iliac and sacrum.

Conflicts of interest
The authors have none to declare.

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