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Application of Radiological DR Plain Films and CT in the Diagnosis of Spinal Fractures

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Abstract: *Objective:* To analyze the effect of using radiographic DR plain films and CT in the diagnosis of spinal fractures. *Methods:* The data of 72 patients with spinal fractures were selected for analysis in the Imaging Department of our hospital from January to December 2023. Radiation DR plain films and CT diagnosis were performed to compare the detection rates of the two methods. *Results:* Compared with radiographic DR plain films, CT had a significantly higher detection rate of fracture fragment displacement, spinal canal volume change, fracture fragment protrusion into the spinal canal, and spinal canal stenosis, $p < 0.05$; comparing the data of the two methods in detecting spinal curvature changes, it was found that $p > 0.05$. *Conclusion:* The effects of using radioactive DR plain films and CT in the diagnosis of spinal fractures are different. CT is recommended for clinical use because it can clearly display the patient's condition and provide a basis for clinical treatment of the patient's condition.

Keywords: Radiation DR plain film; CT; Spinal fracture; Diagnosis; Application effect

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1. Introduction

The human spine carries the weight of the body and protects spinal nerves. Its structural integrity is closely related to the body's movement function and is also related to life safety. Common clinical traumatic diseases include spinal fractures, caused by falls from heights, traffic accidents, heavy objects, etc. In recent years, the incidence rate has increased year by year, which is related to the development of the transportation industry and the expansion of the construction industry. After the disease occurs, if the diagnosis is not timely and accurate, patients are prone to spinal cord nerve compression due to fracture displacement, and are prone to serious complications, such as limb paralysis, urinary and fecal dysfunction, etc., and the patient's quality of life is seriously reduced. Based on this, clinical attention is paid to the early and accurate diagnosis of spinal fractures, which can be used to guide clinical treatment and improve the patient's prognosis [1]. In diagnosing the condition of patients with spinal fractures, the core method is imaging examination, of which radiological DR plain films are low-cost. The advantages of clinical application include simple operation and fast examination speed. After application, basic pathological changes such as changes in the physiological curvature of the spine and the degree of vertebral body compression can be quickly and initially judged. However, because of the patient's Patients have a relatively

complex anatomical structure of the spine, including multiple vertebrae, intervertebral discs, ligaments, and nerve tissue. In addition, two-dimensional image acquisition has problems with tissue overlap and interference. It cannot clearly display subtle lesions such as the displacement direction of the patient's fracture fragments, changes in spinal canal volume, and nerve compression, making it easy to cause misdiagnosis or missed diagnosis [2]. The advantage of CT diagnosis in clinical research is high spatial resolution. The use of tomography can clearly present the three-dimensional anatomical structure of the patient's spine, effectively avoid the impact of tissue overlap, and provide a reliable reference for clinical identification of subtle lesions [3]. This article selected 72 patients to analyze the effect of using radiographic DR plain films and CT in the diagnosis of spinal fractures.

2. Materials and methods

2.1. Information

The data of 72 patients with spinal fractures were selected for analysis in the Imaging Department of our hospital from January to December 2023, 40/32 men and women, aged 18–65 (38.29 ± 3.69) years old.

2.1.1. Inclusion criteria

Meet disease diagnostic criteria; accept and cooperate with radiological DR plain film and CT diagnosis; voluntarily participate and give informed consent.

2.1.2. Exclusion criteria

Accompanied by fractures in other parts; lost to follow-up; suffering from spinal diseases; having cognitive, mental and other problems and unable to cooperate.

2.2. Method

Implementation of radiographic DR plain films and CT diagnosis:

(1) Use a 200 mA X-ray machine to take anteroposterior and lateral radiographs of the injured spinal segment of the patient. If necessary, the open position and double oblique view of the circumflex joint can be added.

(2) Use the United Imaging (uCT530) 40-row scanner. The current, voltage, and scanning layer spacing are 100 mA, 130 kV, and 5 mm in sequence.

Scan the injury site and cross section while lying on your back, and carry out sagittal and coronal reconstruction based on actual conditions.

2.3. Observation indicators

Compare the detection rates of radiographic DR plain films and CT for fracture fragment displacement, spinal canal volume changes, fracture fragment protrusion into the spinal canal, spinal canal stenosis, and spinal curvature changes.

2.4. Statistics

SPSS 28.0 software was used for data analysis. Counting and measurement data were expressed in the form of rate (%) and [$\bar{x} \pm s$]. χ^2 and t tests were carried out respectively. $p < 0.05$ was statistically significant.

3. Results

The surgical results showed that: fracture fragment displacement, spinal canal volume change, fracture fragment protruding into the spinal canal, spinal canal stenosis, and changes in spinal curvature were 56 cases, 35 cases, 51 cases, 27 cases, and

32 cases. Compared with radiographic DR plain films, CT has a significantly higher detection rate of fracture fragment displacement, spinal canal volume change, fracture fragment protrusion into the spinal canal, and spinal canal stenosis, $p < 0.05$; comparing the data of the two methods in detecting changes in spinal curvature, $p > 0.05$.

Table 1. Comparison of the detection rates (%) of the two methods

Group	Displacement of fracture fragment (n = 56)	Spinal canal volume changes (n = 35)	The fracture fragment protruded into the spinal canal (n = 51)	Spinal stenosis (n = 27)	Changes in spinal curvature (n = 32)
Radiographic DR plain film	23 (41.07)	18 (51.43)	25 (49.02)	11 (40.74)	26 (81.25)
CT	51 (91.07)	32 (91.43)	47 (92.16)	25 (92.59)	27 (84.38)
χ^2	31.2262	13.7200	22.8556	16.3333	0.0198
p	< 0.05	< 0.05	< 0.05	< 0.05	> 0.05

4. Discussion

Critical illnesses in the field of orthopedic trauma include spinal fractures, and their diagnostic accuracy is closely related to the patient's treatment plan and prognosis. With the iterative development of clinical imaging technology, core clinical methods have been proposed to diagnose the condition of patients with spinal fractures, including radiographic DR plain films and CT examinations. Both work according to different imaging principles and have their own advantages and limitations. This article studies this.

The core results of this study show that compared with radiographic DR plain films, CT examination has a significantly higher detection rate of key disease indicators such as fracture fragment displacement, spinal canal volume change, fracture fragment protrusion into the spinal canal, and spinal canal stenosis ($p < 0.05$). However, the comparison between the two in the detection rate of spinal curvature changes is not significant ($p > 0.05$). The reasons for the analysis results are mainly due to the differences in the imaging principles of the two inspection technologies, coupled with the joint effects of the anatomical structure characteristics of the spine and the pathological characteristics of the lesions. When analyzing the internal mechanism, we must start from multiple dimensions and conduct in-depth research. The core reason for the differentiation in detection rates is the essential difference in imaging principles. Radiation DR plain films use X-ray beams to penetrate the human body, which is a traditional X-ray imaging technology. It obtains two-dimensional projection images based on the differences in attenuation coefficients of different tissues. It is easy to operate and fast to examine. In a short time, the entire frontal and lateral images of the spine can be obtained. However, during the application process, tissue overlap and interference are easily caused due to the "two-dimensionalization of the three-dimensional structure" [4]. Studying the spinal structure is a complex three-dimensional structure, consisting of vertebral bodies, intervertebral discs, vertebral pedicles, spinous processes, transverse processes, and neural tissue in the spinal canal. In two-dimensional projection, images of each anatomical structure are prone to overlap, especially if the patient has a small displacement of the fracture fragment, or the patient has subtle spinal canal volume changes, or the fracture fragment protrudes into the spinal canal to a small extent. Overlapping images will cover up the details of the patient's pathology, and the patient is prone to misdiagnosis or missed diagnosis during the diagnosis [5]. In this study, the probability of detecting fracture fragment displacement on DR plain films was 41.07%, and spinal canal stenosis was 40.74%, which fully reflects the tissue overlap effect [6]. For example, for patients with vertebral burst fractures, the fracture fragment may be hidden in images of adjacent vertebral bodies or vertebral pedicles after displacement, and its position and direction of displacement cannot be clearly distinguished using DR plain films. Moreover, for changes in spinal canal volume, because there is little difference in the X-ray attenuation coefficient between the cerebrospinal fluid in the spinal canal, spinal cord,

and surrounding bone, volume changes cannot be accurately quantified using two-dimensional images, so the detection rate is not high [7]. CT examination is performed on the patient, and the X-ray beam is rotated around the human body to scan, and continuous cross-sectional images of the patient's spine are obtained through tomographic imaging technology. Through computer reconstruction technology, coronal, sagittal and three-dimensional images are formed. This mode can fundamentally solve the problem of tissue overlap because it has a high spatial resolution and can clearly present the subtle anatomical structure and lesion characteristics of the patient's spine. Clinical analysis shows that the use of CT cross-sectional images can clearly display the displacement of fracture fragments, and can also accurately display the size and number of the patient's fracture fragments. Even if the displacement is millimeter level, it can be accurately identified. In this study, the probability of detecting fracture fragment displacement was 91.07%. CT can quantitatively evaluate the degree of stenosis by measuring the anteroposterior diameter, transverse diameter, and volume of the spinal canal. It can clearly display the depth and range of fracture fragments protruding into the spinal canal. It can provide a reference for nerve compression risk assessment during the detection of spinal canal volume changes and spinal canal stenosis. In this study, CT diagnosis detected changes in spinal canal volume, fracture fragments protruding into the spinal canal, and spinal canal stenosis in more than 90% of cases. In addition, using CT three-dimensional reconstruction technology, the spatial relationship between the overall shape of the spine and fracture displacement can be visually displayed, and clinicians can have a more comprehensive understanding of the patient's pathology [8]. The differences in pathological characteristics of different lesion indicators will also affect the detection efficiency of the two inspection techniques. Spinal curvature changes manifest as straightening of the physiological curvature of the spine, kyphosis, or scoliosis. They have a wide range of lesions and are easy to identify in two-dimensional projection images. By performing DR plain films on patients, the overall curvature of the patient's spine can be clearly understood through the anteroposterior and lateral images. The examination rate in this study was 81.25%, which is similar to the 84.38% of CT. Analysis of the above results shows that the two methods are equally effective in assessing macroscopic changes in the overall curvature of the spine, and DR plain films can be used. In the process of detecting microscopic or local lesions such as fracture fragment displacement and spinal canal volume changes, it is necessary to display details and perform precise spatial positioning during diagnosis. Using DR plain films has limitations in two-dimensional imaging. Using CT diagnosis can fully play its role because its advantage is tomography. For example, the riskiest lesions in spinal fractures include the fracture fragment protruding into the spinal canal. If the penetration range is large, the patient may become paralyzed due to spinal cord nerve compression. During diagnosis, the location, shape, and distance of the fracture fragment from the spinal cord need to be clarified, which cannot be achieved using DR plain films. Using CT diagnosis and accurate presentation of multi-directional reconstructed images can provide a reference for whether the patient needs emergency surgical decompression.

It is of great significance to analyze and optimize the spinal fracture diagnosis process from the perspective of clinical practice. The advantages of using plain radiographic DR films for patients mean that they can still be used as a primary screening method for spinal fractures, especially for emergency trauma patients. In emergency situations, doctors can use this technology to quickly determine whether patients have spinal fractures, changes in spinal curvature, and the degree of vertebral body compression. This will help patients obtain correct first aid in the future, and facilitate clinical examination plans for patients quickly. Moreover, if the patient's economic conditions are limited, or if the patient is a primary medical institution, it is recommended to be used as a cost-effective screening tool. In the study of this article, the results clearly indicate that DR plain films are obviously insufficient in detecting subtle lesions, so this article does not recommend it. If the patient uses DR plain films to detect abnormalities, or the patient's clinical symptoms do not meet the DR results, CT diagnosis can be used to make a clear diagnosis. Especially for patients with symptoms of nerve injury, and for patients who are highly suspected of burst fractures or fracture fragment displacement, CT examination is required as the first choice. In addition, when formulating plans for patients with spinal fractures, the role of CT examination is irreplaceable in assessing the patient's prognosis. For example, doctors can use CT images to accurately understand the location of the fracture fragment, direction of displacement, degree of spinal stenosis, and integrity of the posterior vertebral wall before surgery, and develop a personalized surgical plan for the patient. Using CT diagnosis during the patient's postoperative

review can clearly display the patient's fracture healing status, internal fixation position, and spinal canal volume recovery, and provide reliable data to evaluate the patient's efficacy.

It should be noted that although there are obvious advantages in using CT examination in diagnosing the condition of patients with spinal fractures, there are also shortcomings. Compared with DR plain films, the radiation dose of CT examination is significantly higher. If the patient needs multiple re-examinations, attention should be paid to strict control of the number of examinations. In addition, the cost of CT examination is relatively high. In terms of showing the soft tissues of the spine (such as intervertebral discs, ligaments, and spinal cord), CT examinations for patients are of low value. Based on this, when clinically diagnosing a patient's condition, a comprehensive diagnostic plan should be developed based on the specific situation and the advantages of multiple examination technologies.

The research in this article also has certain limitations, which can be improved and optimized in subsequent research. In this study, a retrospective analysis was used and a single-center study was conducted, which affects the extrapolation of the results. In future studies, the sample size can be expanded and multi-center prospective studies can be implemented to improve the generalizability and reliability of the research results. In this study, the radiation dose and cost-benefit ratio of the two examination technologies were not compared. These indicators can be included in the future for in-depth analysis. This study did not explore the impact of different types of spinal fractures on the detection rates of the two examination techniques. Because the types of spinal fractures have different pathological characteristics, their detection difficulties are also different. In future studies, the diagnosis of different types of spinal fractures can be studied in layers to provide strong evidence for accurate clinical diagnosis of patients' conditions.

In summary, the effects of using radioactive DR plain films and CT in the diagnosis of spinal fractures are different. CT is recommended for clinical use because it can clearly display the patient's condition and provide a basis for clinical treatment of the patient's condition.

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Disclosure statement

The author declares no conflict of interest.

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