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# Analysis of The Value of Multi-Slice Spiral CT and Magnetic Resonance Imaging in The Diagnosis of Carpal Joint Injury

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**Abstract:** *Objective:* To analyze the value of multi-slice spiral computed tomography (CT) and magnetic resonance imaging (MRI) in the diagnosis of carpal joint injury. *Methods:* A total of 130 patients with suspected wrist injuries admitted to the Department of Orthopedics of our hospital from January 2023 to January 2024 were selected and randomly divided into a single group ($n$ = 65) and a joint group ($n$ = 65). The single group was diagnosed using multi-slice spiral CT, and the joint group was diagnosed using multi-slice spiral CT and magnetic resonance imaging, with pathological diagnosis as the gold standard. The diagnostic results of both groups were compared to the gold standard, and the diagnostic energy efficiency of both groups was compared. *Results:* The diagnostic results of the single group compared with the gold standard were significant ($P < 0.05$). The diagnostic results of the joint group compared with the gold standard were not significant ($P > 0.05$). The sensitivity and accuracy of diagnosis in the joint group were significantly higher than that in the single group ($P < 0.05$). The specificity of diagnosis in the joint group was higher as compared to that in the single group ($P > 0.05$). *Conclusion:* The combination of multi-slice spiral CT and MRI was highly accurate in diagnosing wrist injuries, and the misdiagnosis rate and leakage rate were relatively low. Hence, this diagnostic program is recommended to be popularized.

**Keywords:** Multi-slice CT; Magnetic resonance imaging; Carpal joint injury; Joint diagnosis

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## 1. Introduction

The wrist joint is a relatively complex joint, mainly involved in the activities of the upper limb extremities, such as bending and extension. In the process of daily activities, the wrist joint is prone to injury [1]. It is a common clinical condition and the incidence has been on the rise in recent years [2]. Wrist joint injury can be caused by violent blows, excessive force, and other factors, which result in joint pain, tissue swelling, and other symptoms. It is important to treat it promptly, otherwise, it will damage the function of the wrist joint and affect the patient's daily life [3]. For this reason, imaging examinations are carried out during the early stages of wrist joint injury to clarify the diagnosis and develop treatment measures. The anatomical organization of

the wrist joint is very complex and misdiagnosis is common, which can delay the patient's treatment. Multi-slice computed tomography (CT) commonly uses imaging methods to diagnose wrist joint injuries, as the examination speed is very fast and the acquired images have good clarity. Magnetic resonance imaging (MRI) is also a diagnostic modality for wrist injuries, with high resolution, no radiation, and high safety [4]. Multi-slice spiral CT diagnosis of wrist injury is prone to leakage or misdiagnosis, resulting in late diagnosis.

For this reason, the combination of MRI with multilayer spiral CT diagnosis can make up for the defects of these two diagnostic modalities, further improve the diagnostic accuracy, and provide references for the treatment of patients. The purpose of this study is to analyze the value of multi-slice spiral CT and MRI in the diagnosis of wrist joint injury.

## 2. Materials and methods

### 2.1. General information

A total of 130 patients with suspected wrist joint injuries who were admitted to the Department of Orthopedics of our hospital from January 2023 to January 2024 were selected and randomly divided into a single group ($n$ = 65) and a joint group ($n$ = 65). The single group consisted of 38 males and 27 females aged 29–73 years old, with an average age of 51.98 ± 1.37 years. There were 14 cases with elementary school education, 16 cases with junior high school education, 19 cases with high school education, and 16 cases with university education. The joint group consisted of 40 males and 25 females aged 27–73 years old, with an average age of 51.95 ± 1.39 years. There were 12 cases with elementary school education, 18 cases with junior high school education, 17 cases with high school education, and 18 cases with university education. General information (gender, age, and literacy level) of the two groups were comparable but were not significant ($P$ > 0.05). Inclusion criteria: (1) Patients with restricted wrist activities; (2) painful symptoms in the wrist; (3) consented; (4) stopped halfway. Exclusion criteria: (1) Patients with poor compliance; (2) allergic to contrast media. (3) mental disorders; (4) pregnant or lactating women; (5) communication disorders; (6) previous wrist injuries.

### 2.2. Methods

The single group utilized multi-slice spiral CT for diagnosis. The voltage was adjusted to 120 kV, the current was adjusted to 200 mA, the layer thickness was adjusted to 3 mm, and the reconstruction thickness layer was 0.75 mm. The patient's carpal joints were scanned to observe the bone structure and determine the scope of injury. The joint group utilized multi-slice spiral CT and MRI for diagnosis based on the single group. Regarding the MRI, sagittal fast spin echo sequence T2 weighted imaging was performed, the time was set to 3800 ms, echo time adjustment was set as 100 ms. Sagittal and coronal spin echo sequence T2 weighted imaging was then carried out, where the repeat time adjustment was set at 500 ms and the echo time adjustment was 17 ms. The coronal fat suppression technology STIR sequence was performed at a repeat time adjustment of 2500 ms, echo time of 20 ms, layer spacing of 0.1 mm, and a thick layer of 5 mm. The patient's wrist joint was also scanned to observe the changes in the local structure. Pathologic diagnosis was taken as the gold standard.

### 2.3. Observation indexes

The diagnostic results of the single and joint groups were compared with the gold standard, including positive and negative groups. The diagnostic efficiency of the single group and the joint group, including sensitivity, specificity, accuracy, and sensitivity were compared. The judgment standards were as follows: true positive / (true positive + false negative), specificity: true negative / (false positive + true negative), accuracy: (true positive +

true negative)/total.

## 2.4. Statistical analysis

The SPSS 21.0 statistical software was used to process data. Measurement data were expressed as mean ± standard deviation (SD) and the count data were expressed as %. Measurement data were analyzed using a *t*-test, and count data were analyzed using a chi-squared ($\chi^2$) test. Results were considered statistically significant at $P < 0.05$.

# 3. Results

## 3.1. Comparison of diagnostic results between the single group and the gold standard

As shown in **Table 1**, the diagnosis of the single group was positive in 34 cases and negative in 31 cases, and the diagnosis of the gold standard was positive in 49 cases and negative in 16 cases. The difference between the diagnosis results of the single group and the gold standard was statistically significant ($P < 0.05$).

**Table 1.** The comparison of diagnostic results between the two groups and the gold standard [*n* (%)]

| Single group | Gold standard | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive | 29 | 5 | 34 |
| Negative | 20 | 11 | 31 |
| Total | 49 | 16 | 65 |

## 3.2. Comparison of diagnostic results between the joint group and the gold standard

As shown in **Table 2**, the diagnosis of the joint group was positive in 50 cases and negative in 15 cases, and the diagnosis of the gold standard was positive in 51 cases and negative in 14 cases. The difference between the diagnostic results of the joint group and the gold standard was statistically significant ($P > 0.05$).

**Table 2.** Comparison of the diagnostic results between the two groups and the gold standard is as follows [*n* (%)]

| Joint group | Gold standard | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive | 47 | 3 | 50 |
| Negative | 4 | 11 | 15 |
| Total | 51 | 14 | 65 |

## 3.3. Comparison of diagnostic efficacy between the two groups

As shown in **Table 3**, the sensitivity of diagnosis in the single group was 59.18%, the specificity was 31.25%, and the accuracy was 61.54%, while the sensitivity of diagnosis in the joint group was 92.16%, the specificity was 21.43%, and the accuracy was 89.23%. The sensitivity and accuracy of diagnosis in the joint group were significantly higher than those in the single group, ($P < 0.05$). There was no significant difference in the specificity of diagnosis between the two groups ($P > 0.05$).

**Table 3.** Comparison of the diagnostic energy efficiency between the two groups [*n* (%)]

| Group | Cases, *n* | Sensitivity | Specificity | Accuracy |
|---|---|---|---|---|
| Single group | 65 | 59.18 (29/49) | 31.25 (5/16) | 61.54 (40/65) |
| Joint group | 65 | 92.16 (47/51) | 21.43 (3/14) | 89.23 (58/65) |
| $\chi^2$ | - | 14.8958 | 0.3683 | 13.4311 |
| P | - | 0.0001 | 0.5439 | 0.0002 |

## 4. Discussion

Wrist joint injury is a condition that occurs in the wrist joint. The structure of the wrist joint is easily damaged under force, which causes wrist pain and limb movement restriction [5]. Generally, wrist injuries do not exist independently, and many patients have a combination of cartilage injuries, fractures, and joint dislocations. Carpal injuries should be emphasized, otherwise they will leave sequelae and cause irreversible damage [6]. Before the treatment of wrist injuries, the diagnosis and severity of the condition should be clarified so that the appropriate method of treatment can be implemented. The complexity of the wrist joint increases the difficulty of diagnosis of wrist joint injury. X-ray is a simple and cheap routine examination of orthopedic diseases. However, it produces increased radiation, which adversely affects the patient's health [7]. Recently, imaging technology has made great progress, and many new imaging modalities have gradually appeared. Multi-slice spiral CT is a type of CT scan that produces images with higher clarity and a shorter scanning time. It can accurately reflect the situation of wrist joint injury. Multi-slice CT utilizes tapered X-rays and multi-row detection facilities to further improve the image quality. This modality can accomplish three-dimensional reconstruction without the use of contrast media in the diagnostic process [8]. However, multi-slice spiral CT also has certain disadvantages. The detection rate of underlying carpal injuries is low. Hence, MRI is added to the diagnosis using multi-slice spiral CT. MRI is characterized by multi-directional imaging, which observes the specifics of the lesion from multiple perspectives so that the misdiagnosis rate and leakage rate are reduced [9]. MRI works by utilizing the electromagnetic waves emitted to produce clear images. The produced images are high in resolution, and in the process of examination, the specific location of the fracture as well as the specifics of the bone tissue can be clarified. In addition, the examination method is not radioactive and the safety is guaranteed to a certain extent. However, MRI also has certain defects. It is a two-dimensional imaging and cannot locate mobile fracture fragments [10]. Based on this, multi-slice spiral CT and MRI should be taken as a joint procedure to complement each other and avoid misdiagnosis.

This study showed that the comparison of the diagnostic results of the single group with the gold standard was significant ($P < 0.05$). The comparison of the diagnostic results between the joint group and the gold standard was not significant ($P > 0.05$). The sensitivity and accuracy of diagnosis in the joint group were significantly higher than that in the single group ($P < 0.05$). The specificity of diagnosis between the two groups was not significant ($P > 0.05$). In this study, the accuracy of multi-slice spiral CT for the diagnosis of wrist joint injury is low, and there is a very obvious difference when compared with the gold standard. Hence, it is not possible to use multi-slice spiral CT alone to diagnose wrist joint injury. Once misdiagnosis occurs, the optimal treatment period of the patient will be delayed and the patient's prognosis will be affected. Therefore, it is necessary to draw on MRI in the diagnosis of the wrist joint, conduct timely detection of hidden fractures, and improve the accuracy of diagnosis. Multi-slice spiral CT is a type of surface imaging, where three-dimensional reconstruction can be performed after the injection of a contrast agent to locate mobile fracture fragments,

which is an effect that MRI cannot achieve. However, MRI can detect small injuries and also identify the type of wrist injury. The results of multi-slice CT and MRI are closer to the gold standard, with a very small chance of misdiagnosis, and overall high diagnostic accuracy.

## 5. Conclusion

The application of multi-slice spiral CT and MRI in the diagnosis of wrist joint injury has achieved high clinical value. This combination improved the sensitivity and accuracy in the diagnosis of wrist joint injury and is worthy of popularization.

## Disclosure statement

The authors declare no conflict of interest.

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