Application of X-ray digital tomosynthesis in knee joint trauma examination

Li-Sheng Wu, You-Jun Lin, Xiao-Ling Yi, Hai-Na Xu

Department of Radiology, Hainan General Hospital, 570311, Hainan, China

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ABSTRACT

Objective: To explore the clinical value of X-ray digital tomosynthesis (DTS) in the diagnosis of knee joint fractures. Methods: A total of 28 cases of thoracic trauma, X-ray film cannot be clearly diagnosed or can confirm the diagnosis but the need for further identification of forensic diagnosis of cases of DTS scan and three-dimensional reconstruction in order to control the study. Results: 1. The reconstructed images after DTS scanning showed that the knee joint fractures were clearly diagnosed, and the detection rate of 28 knee joint fractures was 92.86%. 2. DTS scanning could clearly detect the fresh knee joint fracture's fracture line, corresponding line and broken bones. For the old fracture, DTS scanning could clearly show the condition of the fracture end's healing. Conclusions: The technique is of great value in the diagnosis of knee joint fracture, especially in the examination of complex structure, thick body and review of internal fixation after fracture.

1. Introduction

X-ray Digital Tomosynthesis (DTS) is a new X-ray technology developed in recent years[1]. With the application of dynamic large size plate detector and the continuous improvement of computer imaging technology, the volume data obtained by one-off scanning can be rebuilt at any multilevel fault image, and it is simple and easy to be done without the limitation of the patient's position. At present, DTS is mainly used for bone joint, lung, bronchial and venous pyelography, and T tube cholangiography, etc[2-4]. This article summarizes 28 cases of knee joint trauma in our hospital, and discusses the application value of tomographic fusion in knee joint trauma examination.

2. Data and methods

2.1. Clinical data

This group was 28 cases of traumatic knee joint fracture. All cases were examined by X-ray plain film. The cases of fracture line were not clear, or abnormal. There were 19 males and 9 females, aged 13-72 years, with an average age of 42.5 years.

2.2. Examination method

(1) X-ray examination equipment: SHIMADZU Safire II multifunctional X-ray machine and image post-processing workstation.

(2) Scan parameters: tube voltage 65-75 kV, tube current 3-5 mA, tube cephalad tilt angle of 10 degrees, a thick layer of 3-5 mm

(3) Scan the body position: the routine is the coronal, sagittal position, when necessary, rotate the patient under the perspective to the appropriate body position, add the arbitrary oblique fault, or carry out the knee joint tomography under the gravity load.

2.3. Statistical methods

The data were processed by SPSS 19.0 software. $\chi^2$ test was used to count data. $P$ value was less than 0.05 as a significant difference.
3. Results

3.1. DTS can detect fractures not found in X-ray examination

28 cases of patients with suspected fracture were examined by routine X-ray examination. The results were not confirmed or abnormal, and 23 cases of new fractures were found by DTS scan (82.14%), 3 cases of old fractures (10.71%), 2 cases of fracture (7.14%), as shown in Figure 1. There were significant differences between the two \( (P<0.01) \) (Table 1).

Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th>Negative</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>DTS</td>
<td>26</td>
<td>2</td>
<td>28</td>
</tr>
<tr>
<td>Common X-ray</td>
<td>0</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>30</td>
<td>56</td>
</tr>
</tbody>
</table>

\[ \chi^2=48.533333, P=0.000000. \]

Figure 1. The detection rate of DTS for normal X light negative fracture.

3.2. DTS diagnosis of different types of fractures

Of the 26 cases of fracture found in DTS, there were 12 cases of wedge split fracture, 46.15%, 1 cases of lateral lateral fractures, 2 cases of medial platform fractures, 7.69% and 6 compression fractures, 5 cases of double condyle fractures, accounting for 19.23%, as illustrated in Figure 2.

Figure 2. DTS diagnosis of different types of fractures.

3.3. DTS scan features of fracture image

The fracture line and the broken bone were clearly shown in the new fracture. The old fracture showed the formation of the callus or the blurred proliferation of the edge of the fracture line. The fracture lines and broken ends of the fracture showed clearly, and there was no overlapping artifact of the obvious outer tissue.

Figure 3. DTS clear bone broken line.

Figure 4. No clear line of fracture was not found in ordinary X-ray.

4. Discussion

The DTS technique transcends conventional digital radiography and original tomography. It can obtain an arbitrary coronary digital image at a checkpoint by a low dose of pulsed X-ray exposure to improve the ability to display and diagnose diseases of the site\[5,6\]. The image made up of DTS is a clear image of a single non layered tissue interference, especially for some specific positions that are not suitable for CT, and the location of MR inspection has a unique economic value. The diagnosis of fracture is limited by posture and posture, especially for the diagnosis of fresh fracture\[7\].

In this study, 28 patients were suspected of fractures. Routine X-ray examination results were not diagnosed or no abnormalities were found. The rate of fresh fractures detected by DTS scanning was 81.14%. Xie Wei et al\[8\] reported that the detection rate of DTS in knee joint trauma is 79%. Our results are similar. It indicates that DTS has more advantages in the diagnosis of fresh fracture than...
conventional X-ray.

The principle of displacement superposition and filtered back projection is applied to image reconstruction method based on X ray digital tomography. The displacement superposition method uses the pixel offset that is proportional to the moving quantity to reconstruct the broken plane image, and the filter back projection method, based on the CT reconstruction method, adjusts the reconstruction function and reduces the artifact. Because of the advantages of computer imaging, DTS has better image quality and no overlapping artifact of obvious outer tissue. It can distinguish fracture of different types, fracture line of fresh fracture, clear end to line and broken bone; it also shows good degree of formation and healing of old fracture callus. The results of this study are similar to those reported by other authors[9].

To sum up, in the examination of knee joint trauma, DTS improves the detection rate of the normal X-ray plain film examination results, and can clearly show the bone structure, fracture line and fracture end. The spatial location of the skeletal anatomy is more intuitionistic than CT, and it can get more details and reduce the amount of exposure and economic burden of the patients. It plays an important guiding role in clinical treatment and prognosis evaluation. With the development of fault technology, more precise and higher resolution continuous images will be collected in the future. The volume of the images will be larger, and the clinical application value will be further reflected[10,11].

Reference