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Benefits of Tomosynthesis for Diagnostic Imaging of Fresh Vertebral Fractures

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1. Introduction

Fresh vertebral fractures often only exhibit mild vertebral collapse at initial examination and are often difficult to discern with radiography. Tomosynthesis (TOMOS) is a tomographic imaging method that uses X-rays and, like CT, allows the evaluation of coronal-sectional slices of the vertebra and can even potentially diagnose vertebral fractures with mild collapse.

2. Objective

The objective of this study was to compare the benefits of radiography and TOMOS in the diagnosis of fresh vertebral fractures.

3. Subjects and Methods

This study included consecutive patients aged 70 years and older who visited our hospital complaining of low back pain between February and September in 2018. At initial examination, we performed frontal view and lateral view radiography and frontal view and lateral view TOMOS in the supine position and the decubitus position. Plain MRI was also performed in all patients within 2 weeks of initial examination for a definite diagnosis of fresh vertebral fractures. Fresh vertebral fractures were diagnosed by TOMOS based on the report by Otake et al[1] **(Fig. 1)**. The sensitivity and specificity of fresh vertebral fracture diagnosis were calculated for radiography and TOMOS. The positive diagnosis rate for fresh vertebral fracture was also calculated for both radiography and TOMOS. For the statistical analysis, the chi-squared test was used and a significant difference was determined based on $P < 0.05$.

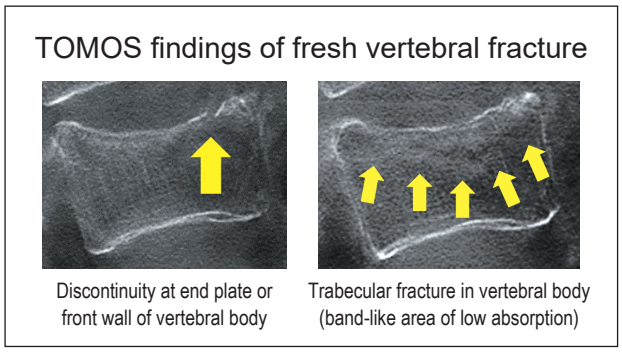

Fig.1 TOMOS Findings of Fresh Vertebral Fracture
(Quoted from Otake et al, MEDICAL NOW, No. 82, 2017.)

4. Results

Eighteen cases were included in this study. Of these cases, 10 (56%) were given a definite diagnosis of fresh vertebral fracture based on plain MRI. The [sensitivity, specificity, and P-value] results for radiography and TOMOS revealing fresh vertebral fractures in these 10 cases were [30%, 100%, and P = 0.09] and [80%, 75%, and P = 0.02], respectively **(Table 1)**. Also, among the 10 cases with a fresh vertebral fracture, the positive diagnosis rate for radiography was 30% (3 cases) and for TOMOS was 80% (8 cases) **(Table 2)**.

Table 1 Sensitivity and Specificity of Radiography and TOMOS for Fresh Vertebral Fracture

	Sensitivity	Specificity	*P*
Radiography	30%	100%	0.09
TOMOS	80%	75%	0.02*

Statistics: Chi-square test

Table 2 Positive Diagnosis Rate of Radiography and TOMOS for Fresh Vertebral Fracture

Among 10 cases with fresh vertebral fracture	
Radiography	3 cases
TOMOS	8 cases

5. A Representative Case

An 80-year old woman had a backache while lifting a futon. She visited our hospital the following day and radiography and TOMOS were performed during the initial examination. Radiography did not identify

a fresh vertebral fracture but TOMOS lateral view images revealed a discontinuity at the upper and lower edge of the end plates of the fourth lumbar vertebra **(Fig. 2)**. A MRI was performed 1 week later and led to a definite diagnosis of fresh vertebral fracture of the fourth lumbar vertebra **(Fig. 3)**.

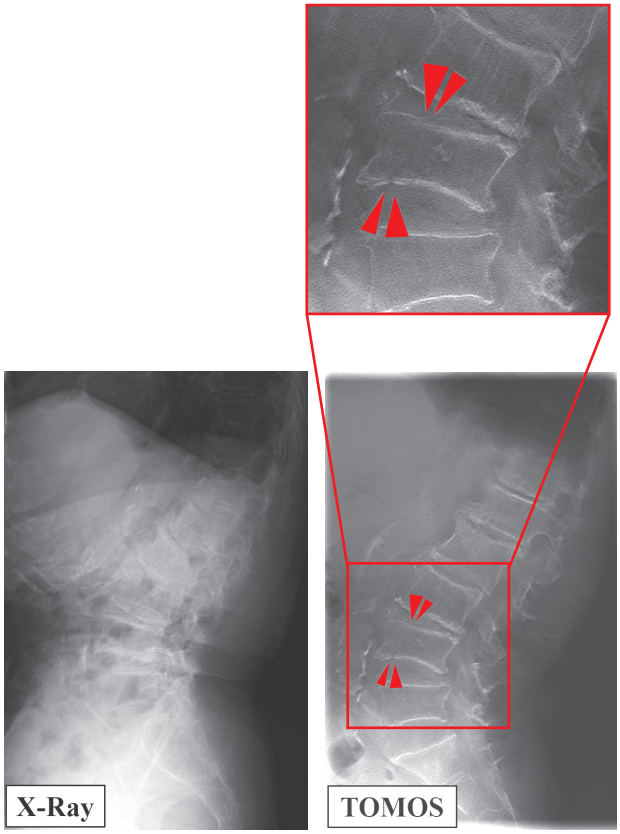

Fig.2 Radiography and TOMOS Lateral Views during Initial Examination of an 80-year-old Woman
Left: Radiographic images do not show clear findings of a fresh vertebral fracture.
Right: TOMOS images show a discontinuity at the upper and lower edge of the end plates of the fourth lumbar vertebra (red arrows).

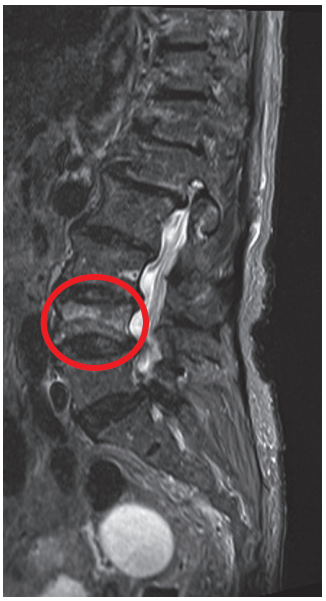

Fig.3 MRI of the 80-year-old Woman Performed 1 Week after Initial Examination
Fresh vertebral fracture shown in fourth lumbar vertebra.

6. Discussion

Fresh vertebral fractures are present in 56% of elderly patients aged 70 or older who complain of low back pain, which is considered a high rate of incidence. Consequently, fresh vertebral fractures must be considered when examining an elderly patient complaining of low back pain. Nakano et al. report that radiography performs poorly in fresh vertebral fracture diagnosis with a very low sensitivity of just 35%[2]. This study also revealed a very low sensitivity and positive diagnosis rate of 30% for radiography in identifying fresh vertebral fractures. Therefore, diagnosis by radiography alone is likely to lead to a high number of missed cases. Radiography is also reported to have difficulty distinguishing between a fresh fracture and an old fracture when a patient has both a mild fracture and a previous fracture, and MRI is the ideal choice for patients with a suspected vertebral body fracture based on their current history or physical findings[3]. However, since not all facilities are capable of performing MRI and due to limiting cost aspect, it is not practical to perform MRI in all elderly patients with low back pain. Given a definite diagnosis of fresh vertebral fracture based on MRI findings, diagnosis by CT is reported to exhibit high sensitivity (89%), high specificity (99%), and also good reproducibility[4]. CT imaging also has the advantage of being easier to perform than MRI. However, despite recent relative improvements, patient exposure is still a problem with CT. TOMOS is reported to have a lower exposure dose than CT[5] and TOMOS imaging is also simpler than CT imaging. The results of this study showed the TOMOS sensitivity and positive diagnosis rate were both high at 80%, and TOMOS missed far fewer cases than radiography. Therefore, diagnosis by TOMOS at initial examination is considered useful for patients with a suspected fresh vertebral fracture.

7. Conclusion

1. Radiography has a low positive diagnosis rate for fresh vertebral fractures and is highly likely to miss these fractures.
2. Diagnosis by TOMOS at initial examination is considered useful for patients with a suspected fresh vertebral fracture.

References

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