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ORIGINAL RESEARCH

Value of CT-Based 3D Reconstruction in Analyzing Fracture Line Distribution in Postmenopausal Women with Osteoporotic Pelvic Fractures

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Objective: This study aimed to evaluate the application value of CT-based 3D reconstruction in analyzing the distribution of pelvic fracture lines and to identify key factors, that affect fracture patterns in postmenopausal women with osteoporotic pelvic fractures.
Methods: A total of 150 postmenopausal female patients with osteoporotic pelvic fractures who underwent CT scans in our radiology department from June 2022 to June 2023 were included. Subjects were divided into a normal group (n=60) and a pelvic fracture group (n=90). CT-based 3D reconstruction was used to analyze the distribution of fracture lines. The correlations between fracture lines and various factors were evaluated, such as age, bone mineral density (BMD) and body mass index (BMI).
Results: The results showed a significant difference in BMD between the pelvic fracture group and the normal group. The average BMD in the pelvic fracture group was 0.763 ± 0.026 g/cm², which was significantly lower than 0.925 ± 0.051 g/cm² in the normal group ($P < 0.001$). This finding suggests that BMD plays an important role in the risk of pelvic fractures. 3D reconstruction revealed that fractures were more widespread in low BMD regions and fewer in high BMD regions, highlighting the correlation between lower BMD and higher fracture risk.
Conclusion: CT-based 3D reconstruction enhances the assessment of pelvic fractures by providing a detailed evaluation of fracture line distribution. This study found that lower bone mineral density is a significant risk factor for pelvic fractures, with a direct correlation to the number and distribution of fracture lines.
Keywords: pelvic, fracture, bone density, CT scans, postmenopausal osteoporoses

Introduction

Pelvic fractures, as common severe traumas in traffic accidents and falls from heights, have always been a challenge in the field of orthopedics in terms of its diagnosis and treatment.[1] Due to the complex anatomical structure and diverse fracture morphology of the pelvis, traditional X-ray and two-dimensional (2D) CT scans have certain limitations in diagnosis.[2] Although these traditional imaging methods can provide basic fracture information, they often lack precision in accurately locating and classifying fracture lines.[3] In addition, 2D images are difficult to provide comprehensive information on the three-dimensional (3D) morphology of fractures and the damage to surrounding soft tissues. However, in osteoporotic patients, where low bone mineral density (BMD) leads to subtle fracture patterns, 3D-CT has shown great value in providing detailed visualization of fracture lines that would be difficult to detect with traditional methods. About 10% of fracture patients suffer from pelvic fractures, which are mainly caused by high-energy injuries such as traffic accidents, falls from heights, and heavy object impacts.[4] These injuries are characterized by severe conditions, including extensive bleeding, organ damage, and high risk of complications, making them a major cause of death and disability in

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acute traumas. Numerous studies have described the epidemiological characteristics of patients with pelvic fractures, but the research content mainly focuses on injury causes, fracture classification, injury score and vital signs.[5]

In recent years, with the rapid development of medical imaging technology, CT-based 3D reconstruction has become a new trend in fracture diagnosis.[6,7] This technology can provide more intuitive 3D fracture images, allowing physicians to more accurately evaluate the type and severity of fractures.[8] For the patients with pelvic fractures, 3D reconstruction can not only clearly display the distribution of fracture lines, but also reveal the relationship between fractures and overall pelvic structure, providing a more accurate basis for clinical treatment.[9] Some scholars have tried to develop a clinical workflow algorithm for preoperative planning, reduction and stabilization of complex acetabular fractures with the support of 3D technologies.[10,11]

The main objective of this study is to explore the value of CT-based 3D reconstruction in analyzing the distribution of fracture lines in postmenopausal female patients with osteoporotic pelvic fractures. By evaluating the correlation between fracture line distribution and factors such as bone mineral density (BMD) and age, this study seeks to identify key factors influencing the fracture patterns specific to this population. Furthermore, a subset of five patients was selected for detailed 3D reconstruction analysis to demonstrate representative fracture patterns and variability in BMD. This focused analysis helps illustrate the practical application of 3D technology in visualizing fracture distribution and provides deeper insight into how low BMD influences fracture line characteristics, offering a clinical perspective on fracture management.

Materials and Methods

Subjects

This study adopted a retrospective study design and was approved by the Ethics Committee of our hospital. A total of 150 postmenopausal female patients and above undergoing CT scans in the Department of Radiology of our hospital from June 2022 to June 2023, with previous fractures of any part, surgeries, infections, or chronic diseases affecting bone metabolism excluded, were consecutively included. According to the presence or absence of pelvic fracture, the subjects were divided into a normal group (n=60) and a pelvic fracture group (n=90). Pelvic fractures are seen in posttraumatic patients. The height, weight, physical activity levels, and medical history of each patient had been recorded, and the body mass index (BMI) and bone mineral density (BMD) were calculated accordingly. The inclusion criteria were as follows: 1. diagnosis of pelvic fractures, including fractures of pelvic structures such as the iliac bones, sacrum, coccyx, pubic bones, or acetabulum. 2. postmenopausal female patients. The exclusion criteria included: 1. complicated with injuries at other anatomical parts, excluding skin or soft tissue injuries; 2. incomplete medical record. 3. associated acetabular injuries in addition to pelvic fractures were also excluded.

Examination Method

CT-Based 3D Reconstruction

CT scans were performed using a 64-slice spiral CT (Philips, Netherlands) with the following parameters: current 100 mA, voltage 120 kV, slice thickness 0.5 mm, and matrix 512×512.[12] Patients were scanned in the supine position, covering from upper margin of ilium to upper margin of ischium, using a tube voltage of 120 kV, tube current of 100–200 mA, slice thickness of 0.5 mm, and a 0.75 mm gap between slices. The raw data were reconstructed with a slice thickness of 1.5 mm and an interval of 1 mm. Volume rendering (VR) and multi-planar reconstruction (MPR) techniques were used for 3D reconstruction, with the software provided by Mindways (USA). According to clinical requirements, the threshold, window width and window level were adjusted for optimal display.[13]

Data Measurements and Processing

After CT scans, the raw data were first uploaded to the Mindways QCT PRO V6.1 station (Mindways, USA) for in-depth data analysis and measurement. This process included the following key steps: Images were selected using the “New QCT slicer ange pick” function in QCT Pro software (Mindways, USA),[14] especially selecting the region “from the upper edge of the white marrow roof to 5 cm away from the lower edge of the lesser trochanter” in coronal images as the reference range for subsequent analysis of axial images. Afterward, QCT scanning data of the patients were loaded through the “New 3D spine exam analysis” program, and the patients’ height and weight were accurately input for verification.[15] Next, the “Extraction” tool was used to place a cross-positioning frame on the axial images between the white marrow, pelvic head, pelvic neck and trochanter, respectively, so that the software could automatically generate 3D reconstructed images of the axial, sagittal and coronal planes at the corresponding positions of the proximal pelvis.[16] For measurement accuracy, the “Rotation” function was used to adjust the positioning frame for BMD to be measured, ensuring that the display of the proximal pelvis on all images was complete and located at the maximum section. When setting regions of interest (ROIs), ROIs were placed in the four designated regions proximal to the pelvis, respectively, ensuring that these regions contained no bone islands or diseased areas. When the same fracture line extends into two or more ROIs, the fracture line is segmented according to the ROI boundaries. The length and position of each segment within its corresponding ROI are recorded separately. During statistical analysis, each segment is treated as an independent part for comprehensive analysis to ensure that the length and position of the fracture lines are accurately recorded and analyzed. To be more specific, when measuring white marrow, an ROI with a diameter of 5 mm was set on the axial image 1 cm above the central section of the white marrow roof. In the measurement of the pelvic head, an ROI with a diameter half of the maximum diameter of the pelvic head was set on the axial image with the maximum display. When measuring the pelvic neck, an ROI was set on the image at the largest section, with a diameter half of the short axis length of the pelvic neck at this section. When measuring BMD at the position between the trochanters, an ROI was set on the axial image at the midpoint of the line connecting the greater and lesser trochanters, with a diameter of half the length of the line, and adjusted on the coronal image. Finally, fat content in muscles was measured through the “Measure Liver Fat” program in the “Extraction” function, which was performed in the BMD measurement section mentioned above. All measurement results were recorded and the BMD obtained from each ROI measurement was saved. Eventually, the averages of all ROIs were taken as the BMD of the proximal pelvis for each patient.

White Marrow: In CT scans, “white marrow” refers to the bone density measurement area located 1 cm above the upper margin of the white marrow.

Pelvic Head: Refers to the pelvic head shown in CT images (Figure 1D).

Pelvic Neck: Refers to the pelvic neck shown in CT images (Figure 1D).

Data Entry and Statistical Analysis

After data collation, statistical analysis and processing were carried out using SPSS 22 (IBM, USA). Categorical variables were expressed using n (%) and continuous variables were expressed using mean ± standard deviation. Shapiro–Wilk test was used for normality testing. Continuous data were compared using independent one-way analysis of variance. Categorical data were analyzed by the $\chi 2$ test. Pearson’s linear correlation test was used to evaluate the correlations between fracture lines and variables such as age, BMD and BMI. $P < 0.05$ was considered as statistically significant.

Results

Comparison of Basic Data

The comparison between the normal group and the pelvic fracture group revealed several key findings. Firstly, the average BMD in the pelvic fracture group was 0.763 ± 0.026 g/cm², which was significantly lower than 0.925 ± 0.051 g/cm² in the normal group, with a statistically extremely significant difference ($P < 0.001$), suggesting that low BMD is a main risk factor for pelvic fractures. In addition, the pelvic fracture group had a significantly higher average weight and BMI compared to the normal group ($P < 0.001$ and $P = 0.006$, respectively). The pelvic fracture group also had a higher percentage of individuals with a past fracture history (30.21% vs 10.43%, $P = 0.00$) and lower physical activity levels (1.21 ± 0.43 hours/week vs 3.32 ± 0.54 hours/week, $P < 0.001$). However, the differences in age or height in this study were not significant ($P = 0.06$, $P = 0.71$). As shown in Table 1.

Correlations Between BMD and the Risk of Fractures

The correlations between fracture lines and variables such as age, BMD and BMI were evaluated using Pearson’s linear correlation test, as seen in Table 2. The results of this study showed that BMD significantly affected the risk of fractures,

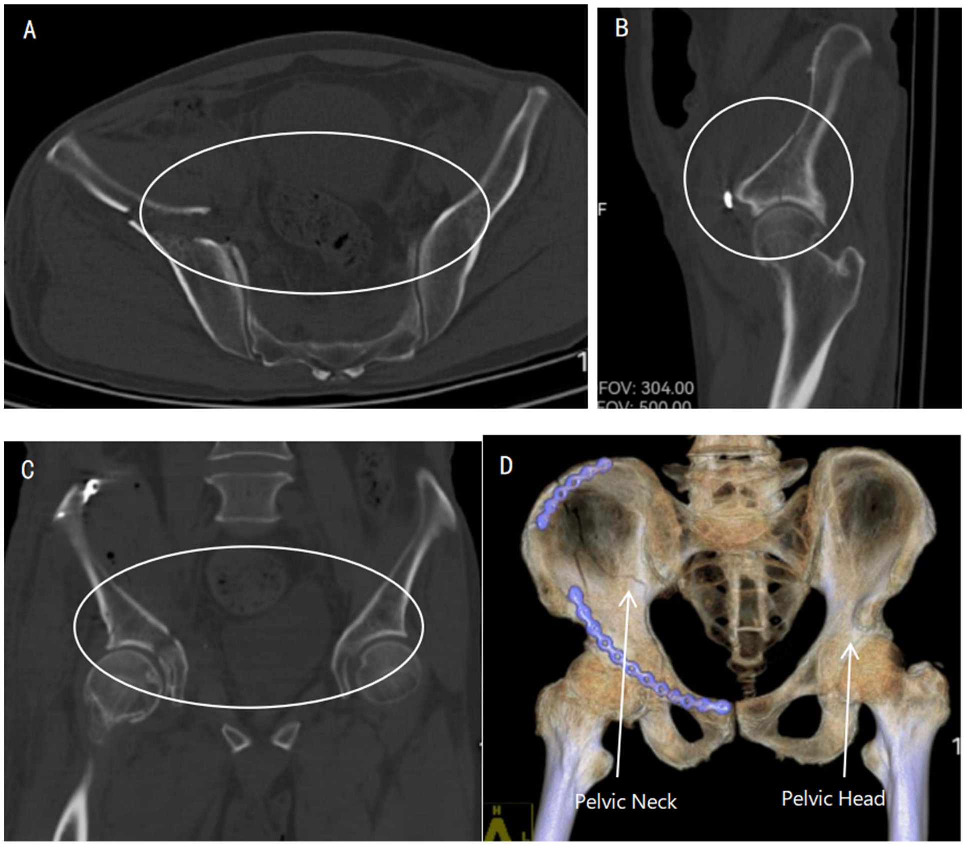

Figure 1 Schematic diagram of CT scan pelvic fracture analysis and process. The white circular areas represent the defined region of interest (ROI) regions. (**A**) Axial view of normal femoral bone structure. (**B**) Sagittal view showing intramedullary nail placement. (**C**) Coronal view with visible callus formation at the fracture site. (**D**) 3D reconstruction illustrating spatial alignment of the implant.

with extreme statistical significance (P < 0.001, OR = 1.175, 95% *CI*: 0.894~1.655), indicating a direct correlation between BMD reduction and a significant increase in fracture risk. As for age, its OR = 65.5, 95% *CI*: 1.8–6.6. Although it was positively correlated with fracture risk, P=0.06, slightly higher than the conventional significance threshold at 0.05. Therefore, this correlation needs to be interpreted more cautiously. Finally, the OR of BMI = 1.2324, with 95% *CI*: 1.232–1.643, but P = 0.15, suggesting that the correlation between BMI and fracture risk is not statistically significant.

Correlation Analysis Between BMD and Fracture Lines

Subsequently, validation analysis was conducted on the correlation between BMD *t*-value and fracture lines on the reconstructed 3D images, as well as the distribution of fracture areas. On the basis of 3D image reconstruction, the patients' fracture lines were overlaid according to the BMD *t*-value, and the correlation between BMD and fracture lines, as well as the distribution of fracture areas were analyzed.

Table 1 Comparison of Basic Data and Bone Mineral Density Between Groups (x ± s, n)

Group	Age (year)	Height (m)	Weight (kg)	BMI (kg/m^2)	BMD (g/cm^2)	Past Fracture History (%)	Physical Activity Level (Hours/Week)
Normal group	65±4.39	1.55±0.06	55.80±8.68	23.41±4.55	0.925±0.051	10.43±0.21	3.32±0.54
Pelvic fracture group	63±6.43	1.57±0.06	56.60±6.94	24.26±2.85	0.763±0.026	30.21±0.32	1.21±0.43
P	0.06^a	0.71^b	<0.001^a	0.006^b	<0.001^a	<0.001^a	<0.001^a

Notes: $^a P$: non-parametric test; $^b P$: one-way analysis of variance.
Abbreviations: BMI, body mass index; BMD, bone mineral density.

Table 2 Correlation Analysis Between Various Observation Indicators and Fracture Lines

Observation Indicators	OR	95% CI		*P value*
		Lower	Upper	
Age	65.5	1.8	6.6	0.07
BMD	1.175	0.894	1.655	<0.001
BMI	1.2324	1.232	1.643	0.15

Abbreviations: BMI, body mass index; BMD, bone mineral density.

Table 3 Distribution of Fracture Lines in Different BMD Regions

BMD Region	Number of Fracture Lines	Average BMD *t*-value	Fracture Risk
High BMD (T ≥ −1.0)	10	−1.0	5%
Medium BMD (−1.0~ −2.5)	30	−2.5	15%
Low BMD (< −2.5)	50	−3.5	25%

Abbreviation: BMD, bone mineral density.

Through statistical analysis of patient data, a significant correlation was observed between the risk of pelvic fractures and BMD. Specifically, the number of pelvic fracture lines in regions with high BMD was smaller, indicating a lower risk of fractures in these regions. On the contrary, as BMD decreased, the number of pelvic fracture lines increased, especially in regions with low BMD, where the risk of fractures significantly increased (Table 3).

Afterwards, five of the patients were further analyzed, and a 3D reconstruction model of their images is shown in Figure 1. It was found that in the low BMD group (t-value ≤ −2.5), patients 1, 2 and 5 had lower BMD t-values and more fracture lines (5, 4 and 6, respectively). These fracture lines were distributed in different regions of the pelvis, including anterior-posterior (X-coordinate), left-right (Y-coordinate) and top-bottom (Z-coordinate) directions, indicating a higher risk and widespread distribution of fractures in regions with low BMD. In the medium BMD group (−2.5 < t-value < −1.0), patients 3 and 4 presented higher BMD t-values and fewer fracture lines (2 and 1, respectively), which were mainly concentrated in specific regions of the pelvis, suggesting that in regions with medium BMD, the risk of fractures is lower and fractures are more concentrated. In the high BMD group (t-value ≥ −1.0), patient 6 showed the highest BMD t-value and no fracture line, indicating that in regions with high BMD, the risk of fractures may be the lowest. By combining BMD data with the 3D coordinate position of the pelvic fracture lines, significant correlations were observed between BMD and fracture risk, as well as its distribution in the pelvis. Patients with low BMD tended to have more fracture lines and a wider distribution, indicating a higher risk of fractures. On the contrary, patients with high BMD had the lowest risk of fractures (Table 4).

Table 4 3D Simulation of the Positional Relationship Between BMD and Fracture Lines

Patient	BMD *t*-value	Number of Fracture Lines	Fracture Line Position (X, Y, Z-coordinate)
1	−3.2	5	(2, 3, 1), (4, 5, 2), (3, 2, 4), (5, 4, 3), (6, 6, 1)
2	−2.9	4	(3, 4, 2), (5, 3, 1), (4, 2, 3), (2, 5, 2)
3	−1.8	2	(4, 1, 3), (3, 2, 2)
4	−1.2	1	(2, 2, 4)
5	−3.5	6	(1, 3, 2), (2, 4, 1), (3, 5, 3), (4, 6, 2), (5, 2, 4), (6, 1, 3)

Abbreviations: X-coordinate, from anterior to posterior; Y-coordinate, from left to right; Z-coordinate, from bottom to top; BMD, bone mineral density.

Discussion

Pelvic fractures, particularly in postmenopausal women with osteoporosis, present significant clinical challenges due to their complex nature and the limitations of traditional imaging techniques. This study aimed to explore the value of CT-based 3D reconstruction in analyzing pelvic fracture line distribution and to assess the relationships between fracture characteristics and various risk factors, including bone mineral density (BMD), age, and BMI. Our findings indicate that lower BMD is a critical risk factor for pelvic fractures, which aligns with existing literature highlighting the increased susceptibility of osteoporotic bone to fractures. The use of CT-based 3D reconstruction proved highly effective in providing detailed and precise images of fracture lines and their distribution.[17]

Our study revealed a significant correlation between BMD and the risk of pelvic fractures, which is consistent with the study by Qaseem et al[18] reporting a correlation between low BMD and increased fracture risk. Furthermore, in our study, the correlation between the distribution pattern of fracture lines (number and location of fracture lines) and BMD provides a new perspective on fracture prevention and treatment which is in line with the study of van den Bergh et al,[19] who pointed out that fracture patterns can guide the development of clinical treatment strategies. However, our study observed no significant correlation of age with fracture risk, which contradicts the finding of Marks et al[20] that age is an important factor in fracture risk. This difference may result from the sample characteristics and study design in our study. Our study identified correlations between varying BMD levels and specific types of pelvic fractures. Notably, we found a significant association between extremely low BMD and the incidence of fractures, suggesting a potential link to increased skeletal fragility in patients with osteoporosis, which warrants further investigation and literature support.[21] What's more, it was also found that even within the normal range of BMD, the risk of fractures increased with a decrease in BMD, suggesting that we should pay more attention to subcritical populations in fracture prevention strategies.

3D reconstruction imaging offers significant advantages in the diagnosis and treatment planning of fractures across two main aspects. Firstly, it enables precise localization and classification of fracture lines by providing detailed three-dimensional structures. This enhanced clarity aids doctors in accurately identifying and categorizing fractures, thereby improving diagnostic accuracy. Moreover, 3D imaging facilitates the assessment of the relationship between fractures and surrounding anatomical structures. By clearly displaying these relationships, including the pelvic structure and adjacent tissues, it provides a solid foundation for developing more effective treatment strategies. Additionally, the vivid visualization effects of 3D images help both doctors and patients better understand the complexity of the injury. This visual clarity enhances communication and supports collaborative decision-making in treatment planning. Furthermore, 3D reconstruction imaging excels in detecting non-displaced fracture lines that might be missed by traditional 2D imaging methods. Its high-resolution and comprehensive views enable the identification of subtle fractures, contributing to a more thorough and accurate diagnosis overall.

The main limitation of this study lies in that the sample size is relatively small and restricted to a specific population (postmenopausal women). As a result, our conclusion may be inapplicable to a wider population. In addition, due to the retrospective design of this study, there may be selection bias and information bias. Despite its limitations, this study emphasizes the importance of BMD in assessing the risk of pelvic fractures and provides valuable evidence for improving fracture diagnosis using 3D reconstruction. These findings are of important clinical significance for developing targeted prevention and treatment strategies, especially in patients with osteoporosis. In the future, larger-scale multi-center research is needed to validate our findings and explore other factors that may affect fracture risk. Moreover, the research should be extended to different populations, including males and younger patients, to improve the universal applicability of the conclusions.

Conclusion

In conclusion, our study highlights the value of CT-based 3D reconstruction in visualizing pelvic fracture lines and their distribution patterns. This can suggest the exact location of the pelvic fracture and can be an important aid when we are treating it with internal or external fixation. This study also found that lower BMD is a significant risk factor for pelvic fractures, with a direct correlation to the number and distribution of fracture lines. Therefore, the need for osteoporosis screening and management should be part of pelvic fractures prevention strategies. While CT-based 3D reconstruction enhances visualization, further research is needed to evaluate its direct role in treatment planning and management.

Data Sharing Statement

All data generated or analyzed during this study are included in this article.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the declaration of Helsinki. All participants provided written informed consent. The protocol of this study was approved by the Ethics Committee of Xinjiang Production and Construction Corps Hospital. All methods were carried out in accordance with relevant guidelines and regulations.

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Disclosure

The authors declare that they have no conflict of interest.

References

1. Küper MA, Bachmann R, Wenig GF, et al. Associated abdominal injuries do not influence quality of care in pelvic fractures-a multicenter cohort study from the German Pelvic Registry. *World J Emerg Surg*. 2020;15:8. doi:10.1186/s13017-020-0290-x
2. Balbachevsky D, Belloti JC, Doca DG, et al. Treatment of pelvic fractures - a national survey. *Injury*. 2014;45(Suppl 5):S46–51. doi:10.1016/S0020-1383(14)70021-X
3. Wharton RMH, Trowbridge S, Simpson A, Sarraf KM, Jabbar Y. Anatomic, diagnostic and management challenges in paediatric pelvic injuries: a review. *J Pediatr Orthop B*. 2019;28:476–486. doi:10.1097/BPB.0000000000000591
4. Breuil V, Roux CH, Carle GF. Pelvic fractures: epidemiology, consequences, and medical management. *Curr Opin Rheumatol*. 2016;28:442–447. doi:10.1097/BOR.0000000000000293
5. Mi M, Kanakaris NK, Wu X, Giannoudis PV. Management and outcomes of open pelvic fractures: an update. *Injury*. 2021;52:2738–2745. doi:10.1016/j.injury.2020.02.096
6. Roll C, Schirmbeck J, Müller F, Neumann C, Kinner B. Value of 3D reconstructions of CT scans for calcaneal fracture assessment. *Foot Ankle Int*. 2016;37:1211–1217. doi:10.1177/1071100716660824
7. Halai M, Hester T, Buckley RE. Does 3D CT reconstruction help the surgeon to preoperatively assess calcaneal fractures? *Foot*. 2020;43:101659. doi:10.1016/j.foot.2019.101659
8. Zeng J, Xu C, Xu G, et al. Evaluation of ankle fractures in 228 patients from a single center using three-dimensional computed tomography mapping. *Front Bioeng Biotechnol*. 2022;10:855114. doi:10.3389/fbioe.2022.855114
9. Vengrenyuk Y, Cardoso L, Weinbaum S. Micro-CT based analysis of a new paradigm for vulnerable plaque rupture: cellular microcalcifications in fibrous caps. *Mol Cell Biomech*. 2008;5:37–47.
10. Solyom A, Moldovan F, Moldovan L, Strnad G, Fodor P. Clinical workflow algorithm for preoperative planning, reduction and stabilization of complex acetabular fractures with the support of three-dimensional technologies. *J Clin Med*. 2024;13(13):3891. doi:10.3390/jcm13133891
11. Fornaro J, Keel M, Harders M, Marincek B, Székely G, Frauenfelder T. An interactive surgical planning tool for acetabular fractures: initial results. *J Orthop Surg Res*. 2010;5:50. doi:10.1186/1749-799X-5-50
12. Grassi L, Väänänen SP, Ristinmaa M, Jurvelin JS, Isaksson H. Prediction of femoral strength using 3D finite element models reconstructed from DXA images: validation against experiments. *Biomech Model Mechanobiol*. 2017;16:989–1000. doi:10.1007/s10237-016-0866-2
13. Wollschlaeger LM, Boos J, Jungbluth P, et al. Is CT-based cinematic rendering superior to volume rendering technique in the preoperative evaluation of multifragmentary intraarticular lower extremity fractures? *Eur J Radiol*. 2020;126:108911. doi:10.1016/j.ejrad.2020.108911
14. Schwarzenberg P, Darwiche S, Yoon RS, Dailey HL. Imaging modalities to assess fracture healing. *Curr Osteoporos Rep*. 2020;18:169–179. doi:10.1007/s11914-020-00584-5
15. Zhou QQ, Tang W, Wang J, et al. Automatic detection and classification of rib fractures based on patients' CT images and clinical information via convolutional neural network. *Eur Radiol*. 2021;31:3815–3825. doi:10.1007/s00330-020-07418-z
16. Li J, Xiang Z, Zhou J, Zhang M. Three-dimensional reconstruction of a CT image under deep learning algorithm to evaluate the application of percutaneous kyphoplasty in osteoporotic thoracolumbar compression fractures. *Contrast Media mol Imaging*. 2022;2022:9107021. doi:10.1155/2022/9107021
17. Adams JD, Marshall WA. The use of tranexamic acid in hip and pelvic fracture surgeries. *J Am Acad Orthop Surg*. 2021;29:e576–e583. doi:10.5435/JAAOS-D-20-00750
18. Qaseem A, Hicks LA, Etxeandia-Ikobaltzeta I, et al. Pharmacologic treatment of primary osteoporosis or low bone mass to prevent fractures in adults: a living clinical guideline from the American College of Physicians. *Ann Intern Med*. 2023;176:224–238. doi:10.7326/M22-1034
19. van den Bergh JP, van Geel TA, Geusens PP. Osteoporosis, frailty and fracture: implications for case finding and therapy. *Nat Rev Rheumatol*. 2012;8:163–172. doi:10.1038/nrrheum.2011.217
20. Marks R. Hip fracture muscle associations: examining 70 years of evidence in favor of more targeted and timely muscle oriented prevention and intervention approaches. *EC Orthopaedics*. 2022;13:18–30.
21. Kim D, Han A, Park Y. Association of dietary total antioxidant capacity with bone mass and osteoporosis risk in Korean women: analysis of the Korea National Health and nutrition examination survey 2008–2011. *Nutrients*. 2021;13:1149. doi:10.3390/nu13041149

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