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THE ROLE OF BONE DENSITOMETRY, DISC AND OSTEOPHYTE SCORES IN OSTEOPOROTIC VERTEBRAL FRACTURE

KEMİK DANSİTOMETRİSİ, DİSK VE OSTEOFİT SKORLARININ OSTEOPOROTİK VERTEBRA KIRIKLARINDAKİ ROLÜ

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SUMMARY

Background: Osteoporosis and osteoarthritis are diseases of the musculoskeletal system, and the two are considered to be different diseases that result from different pathomechanisms. An association between spinal osteoporosis and spondylosis was investigated, and an inverse relationship between decreased bone mineral density (BMD) and spondylosis was reported.

Purpose: This study aims to examine the relationship between vertebral fractures, spondylosis, and BMD in patients who received surgery for vertebral fractures, by using scoring systems and considering other structural factors that might contribute to osteoporosis and osteoarthritis.

Materials and Methods: The participants were 26 patients who had undergone kyphoplasty due to osteoporotic vertebral compression fractures, and 23 patients who had been diagnosed with osteoporosis by clinical examination but had no fractures. Dorsal and lumbar spine radiographs were taken of all patients, and their bone mineral density was measured. Osteophyte development was assessed according to Nathan's classification. The disc score was calculated based on the rate of decrease in disc height. The bone mineral density of all patients was measured in the lumbar and proximal femur regions using DEXA (Dual X-Ray Absorptiometry).

Results: The number of vertebral fractures was only significantly related to the osteophyte scores ($p<0.05$). There was a significant relationship between the disc score and osteophyte score ($p<0.05$). There was a significant difference between the vertebral t-scores of the fracture and non-fracture groups ($p<0.05$). The only parameter from the DEXA score which affected the vertebral fracture was the z-score of the intertrochanteric area ($p<0.05$).

Conclusion: We are of the opinion that it is important to assess and interpret the hip BMD, clinical fracture risk factors, and bone quality components of these patients.

Key words: Osteoporosis, kyphoplasty, osteophyte score, disc score, DEXA bone densitometry, osteoporotic spine fracture.

Level of evidence: Retrospective clinical study, Level III.

ÖZET

Geçmiş Bilgiler: Osteoporoz ve osteoartrit kas-iskelet sistemi hastalıklarıdır ve iki farklı patolojik mekanizmadan kaynaklandığı düşünülmektedir. Spinal osteoporoz ile spondiloz arasındaki ilişki araştırılmış ve kemik mineral yoğunluğu (KMY) ve spondiloz arasında ters bir ilişki bildirilmiştir.

Amaç: Bu çalışma, skorlama sistemlerini kullanarak ve osteoporoz ve osteoartrit katkıda bulunabilecek diğer yapısal faktörler göz önüne alınarak, vertebra kırıkları için ameliyat olan hastalarda vertebra kırığı, spondiloz ve KMY arasındaki ilişkiyi incelemeyi amaçlamaktadır.

Gereç ve Yöntemler: Osteoporotik vertebra kompresyon kırığı nedeniyle ve klinik muayenede osteoporoz tanısı almış ancak herhangi bir kırığı olmayan 23 hastayla, kifoplasti geçirmiş 26 hasta çalışmaya dâhil edilmiştir. Tüm hastaların torakal ve lomber vertebra grafileri çekilmiş ve kemik mineral yoğunluğu ölçümleri yapılmıştır. Osteofit gelişimi Nathan'ın sınıflamasına göre değerlendirilmiştir. Disk puanı disk yüksekliğinde azalma oranına göre hesaplanmıştır. Tüm hastaların kemik mineral yoğunluğu DEXA (Dual X-ray Absorpsiyometre) kullanarak lomber ve proksimal femur ölçülmüştür.

Sonuçlar: Vertebra kırıklarının sayısı ile osteofit skorları ($p<0.05$) arasında anlamlı ilişkili bulunmuştur. Disk skoru ile osteofit skorları arasında anlamlı ilişki saptandı ($p <0.05$). Kırık olmayan grubun ile kırık olan grubun vertebralarındaki t-puanları arasında anlamlı bir fark saptandı ($p <0.05$). DEXA incelemesinde vertebra kırığı etkileyen tek parametre intertrokanterik alanın ($p <0.05$) z-skoru oldu.

Sonuç: Klinik olarak vertebra kırığı risk faktörleri incelemesinde, kalça KMY, kemik kalitesi bileşenleri yorumlarken göz önünde bulundurulması gereken bir birleşendir.

Anahtar kelimeler: Osteoporoz, kifoplasti, osteofit skoru, disk skoru, DEXA kemik dansitometrisi, osteoporotik omurga kırığı

Kanıt düzeyi: Retrospektif klinik çalışma, Düzey III

INTRODUCTION

Osteoporotic vertebral compression fractures are common among geriatric patient populations and may result in osteoporotic spinal deformities with acute or chronic symptoms. Osteoporotic vertebral fractures decrease mobility, adversely affect quality of life, and may even shorten life span. It is critical to avoid this type of fracture, as the outcome of decreased mobility resembles the consequences of hip fractures[6].

Osteoporosis and osteoarthritis are diseases of the musculoskeletal system whose prevalence increase with an aging population and cause morbidity and mortality[1,15]. In general, the two are considered to be different diseases that result from different pathomechanisms[12]. Previous studies have investigated the association between spinal osteoporosis and spondylosis, and have reported an inverse relationship between decreased bone mineral density (BMD) and spondylosis[5,16,19]. However, other studies have reported contrasting results[7,12]. Apart from Miyakoshi's study, which investigated the relationship between osteoporosis and spondylosis among postmenopausal female patients and assessed spondylosis with quantitative scoring, many other studies used qualitative scoring systems to assess spondylosis[12]. In addition, studies on the relationship between spondylosis and BMD did not consider the physical and structural factors that might contribute to osteoporosis and osteoarthritis.

This study aims to examine the relationship between vertebral fractures, spondylosis and BMD in patients who received surgery for vertebral fractures, using scoring systems and considering other structural factors that might contribute to osteoporosis and osteoarthritis.

MATERIALS AND METHODS

The participants were 26 patients who had undergone kyphoplasty due to osteoporotic vertebral compression fractures at Başkent University Practice and Research Hospital in Istanbul (Group 1), and 23 patients who were diagnosed with osteoporosis on clinical examination but had no fractures (Group 2). The exclusion criteria included a history of diseases that may affect bone metabolism, such as rheumatoid arthritis, ankylosing spondylitis, or malignancy, osteoporosis treatment or any other treatment that may affect bone metabolism such as use of corticosteroids or anticonvulsants, androgen deficiency therapy, evidence of abdominal aortic calcification in lumbosacralradiographs, vertebral anomalies, or scoliosis. Dorsal and lumbar spine radiographs were taken of all patients, and bone mineral density measurements were made. Dorsal and lumbar radiographs were taken at the 100 cm centralizing T8 level in the thoracic and the L3 level in the lumbar vertebrae, and assessed with respect to spondylosis. Osteophyte development was assessed according to Nathan's classification. It was assessed for each vertebra as 0 (zero or one degrees), 1 (two degrees), or 2 (three or four degrees), and the osteophyte score was defined from T4–5 to L4–5 (3,8). The disc score was calculated based on the rate of decrease in disc height. For this calculation, the least degenerated L1–2 disc space height was taken as normal. The disc score was calculated as 0 (20% decrease), 1 (20–50% decrease), or 2 (50% decrease). The total score was obtained by adding all the disc scores from the L1–2 to the L5–S1 disc spaces[4,9]. The bone mineral density of all patients was measured in the lumbar and proximal femurs using DEXA (Dual X-Ray Absorptiometry).

Physical activity was assessed using the physical activity score (PAS) mentioned in the European Vertebral Osteoporosis Study (EVOS) survey [3,11].

The data obtained were statistically analyzed using the SPSS 16.0 package. A Wilcoxon test was used to correlate the parameters between the fracture and non-fracture groups, and a linear regression test was used to examine the effect of parameters on osteoporotic compression fractures of vertebrae. A p-value <0.05 was considered significant.

RESULTS

There were 22 female and four male patients in Group 1, and their mean age was 67.8 years (SD=12.7). Group 2 consisted of 18 females and five males, and their mean age was 68.6 years (SD=13.3). The relationships between bone mineral density measurements and osteophyte and disc scores were studied. Descriptive analyses and statistical examination of the DEXA scores, disc and osteophyte scores are described in Table-1. The number of vertebral fractures was only significantly related to the osteophyte scores ($p<0.05$). No statistically significant results were obtained between the DEXA scores and disc score or osteophyte score. However, there was a significant relationship between the disc score and osteophyte score ($p<0.05$) There was a significant difference between the vertebral t-scores of the fracture and non-fracture groups ($p<0.05$). However, the only parameter from the DEXA score which affected vertebral fracture was the z-score of the intertrochanteric area ($p<0.05$).

Table-1. Descriptive analyses and statistical examination of DEXA scores, disc and osteophyte scores.

	Mean ± SD of non-fracture group	Mean ± SD of fracture group	Differences between the groups p value	Regression of the parameter with respect to the fracture p-value
Vertebral DEXA Score				
t-L1	-2.35±0.50	-2.84±0.93	***0.03***	0.877
t-L2	-2.38±0.71	-2.90±1.57	***0.004***	0.457
t-L3	-2.29±0.66	-3.29±1.18	***0.003***	0.671
t-L4	-2.52±0.82	-3.41±1.35	***0.011***	0.209
t-Summary	-2.37±0.60	-3.16±1.08	***0.008***	0.435
z-L1	-1.05±0.61	-1.30±1.31	0.149	0.600
z-L2	-1.09±0.51	-1.24±1.71	0.286	0.401
z-L3	-1.10±0.68	-1.62±1.39	0.107	0.555
z-L4	-1.03±0.81	-1.73±1.58	0.053	0.950
z-Summary	-1.11±0.59	-1.58±1.33	0.113	0.707
Femur DEXA Score				
t-Neck	-1.53±0.51	-1.80±1.05	0.376	0.624
t-Trochanteric	-1.61±0.51	-1.76±0.92	0.420	0.398
t-Intertrochanteric	-1.45±0.57	-1.57±1.12	0.695	0.312
t-Wards	-1.60±0.70	-2.01±1.21	0.227	0.657
t-Summary	-1.52±0.45	-1.72±1.03	0.409	0.528
z-Neck	-0.72±0.40	-0.62±1.20	0.794	0.262
z-Trochanteric	-0.68±0.57	-0.90±1.04	0.112	0.390
z-Intertrochanteric	-0.55±0.42	-0.76±1.14	0.338	***0.037***
z-Wards	-0.70±0.37	-0.61±1.33	0.943	0.601
z-Summary	-0.60±0.51	-0.68±1.25	0.276	0.440
Disc and osteophyte scores				
Disc score	4.83±1.97	4.00±1.84	0.119	0.195
Osteophyte score	12.48±4.97	12.04±5.18	0.573	0.237

DISCUSSION

The method that we used for our calculations, DEXA, is a common and reliable method for measuring trabecular and cortical bone density[7]. However, DEXA measurement is two-dimensional and has the disadvantage of also measuring osteophytes, reactive vertebral sclerosis, hypertrophic posterior elements and vascular calcifications[8,10]. Miedany et al. reported that measuring the antero-posterior bone mineral density with DEXA also assesses the posterior elements rich in cortical bone, while what really needs to be measured is the trabecular bone density in the vertebral corpus[3].

Ito et al. measured lumbar trabecular and cortical bone mineral density separately with quantitative computerized tomography (QCT), and concluded that trabecular bone mineral density decreases with age regardless of the presence of osteophytes, while cortical bone mineral density decreases only in patients without osteophytes. They thus emphasized that degenerative changes in the spine do not increase the trabecular bone mineral density. They concluded that osteophyte development is not associated with bone loss. They even argued that the presence of osteophytes leads to high measurements of bone density, and that measurement of bone mineral density with DEXA poses problems in the assessment of fracture risk[7]. In support of these findings, we found that spinal degenerative changes elevated bone mineral density, while we found no meaningful relationship between the number of vertebral fractures and bone mineral density. We also found that total femoral bone mineral density is a factor that affects the development of vertebral fractures.

Osteoporosis and spondylosis are among the most common musculoskeletal diseases among patients aged over 60. There are many studies in the literature that reveal an inverse relationship between osteoporosis and spondylosis[5,12,16]. To illustrate, Miyakoshi et al. found a positive relationship between osteophytes, disc scores and lumbar bone mineral density in postmenopausal female patients, and a adverse and meaningful relationship between the number of vertebral fractures and bone mineral density[15]. Conversely, other studies have shown no such relationship and thus argued that osteoporosis and spondylosis are two separate diseases[4,9,19]. Many previous studies have assessed the severity of spondylosis with simple qualitative scoring systems, and reported the need for appropriate quantitative scoring systems to reveal the relationship between bone density and degeneration[15,19]. Therefore, in our study, we used osteophyte and disc scores with which we semi-quantitatively assessed spondylosis[5,10,11]. We found no meaningful correlation between osteophytes, disc scores and DEXA scores. The hypothesis is that increased disc and osteophyte scores mean higher lumbar bone mineral density, thus indicating an inverse relationship between spondylosis and osteoporosis. However, there was no significant relationship between the disc score and osteoporotic fracture. We did not detect a meaningful relationship between the number of subclinical vertebral fractures and lumbar BMD values among patients aged over 60. However, the OFELY study found that spondylosis leads to high bone mineral density in postmenopausal women, and far from decreasing the vertebral fracture risk, the decrease in disc space is associated with a significantly higher vertebral fracture risk[17].

Similarly, Jones et al.[14] wrote that spondylosis falsely elevates the spinal bone mineral density, therefore, a high BMD due to osteophytosis does not decrease the risk of fractures, and femoral neck bone mineral density measurements are more valuable in identifying risk. There are other studies in the literature that also emphasize that spondylosis falsely elevates spinal bone mineral density[15].

Bone quality is defined as a trait that includes the material, structural and mechanical characteristics of bones and contributes to bone mass, endurance and strength. In the National Institute of Health (NIH) consensus development meeting held in 2000, osteoporosis was defined as a disease which increases the risk of fractures and is characterized by a reduction in bone strength and endurance, while the concepts of BMD and bone quality were mentioned as the two factors that comprise bone strength[13,14].

Bone mineral density measurements made using DEXA cover 60–70% of the variables that comprise bone strength[17,18]. However, to examine the risk of vertebral femoral fracture, DEXA measurements also have to be used. In our study, the only parameter significantly related to vertebral fracture was the z-score of the intertrochanteric area of the femur. BMD alone is not adequate to explain osteoporosis progression or vertebral fracture development. Arden et al. concluded in their study that osteoarthritis alone in the lumbar region meaningfully decreases the risk of fractures, hip osteoarthritis meaningfully increases the risk of hip fractures, and hand or knee osteoarthritis is not related to the risk. They even found a more meaningful relationship between femoral osteophytes and the risk of hip fractures compared to joint space narrowing, and reported that osteophytes cause bone quality changes that cannot be detected by bone densitometer and result in bone fragility[2,15,20]. In our study, no meaningful relationship was found between sub-clinical vertebral fractures and spondylosis, which poses the question whether vertebral osteophytes have an effect on bone strength and endurance.

When a correlation analysis was undertaken to study the factors associated with vertebral fractures, the z-score of the intertrochanteric area in femoral BMD measurements was the factor affecting vertebral fracture development. Our results may be validated by studies of larger patient groups that investigate all factors affecting vertebral fractures with regression analysis.

In our study, statistically meaningful results were obtained on comparison of the vertebral t-score of the two groups. The regression test revealed a meaningful effect of the z-score of the intertrochanteric region with a p-value under 0.05. Even though the power of these statistical comparisons may be decreased by our limited number of patients, we are of the opinion that the z-value in the intertrochanteric region may particularly be used to identify the risk of vertebral fractures.

Spinal degenerative changes over the age of 60 increase the lumbar bone mineral density; however, this increase does not prevent subclinical vertebral fracture development. Therefore, it is believed that spinal degenerative changes probably lead to falsely elevated BMD among these patients. Total femoral bone mineral density measurements, which we found to be associated with vertebral fracture development, may be used in establishing the risk of fractures among these patients. The number of subclinical vertebral fractures was also found to increase together with the osteophyte scores, suggesting degeneration in these patients. This finding suggests that vertebral osteophytes may affect vertebral mobility, bone strength, and ultimately endurance. When identifying the risk of fractures in male patients with intense vertebral degenerative changes, a lumbar BMD measurement with DEXA may be inadequate. Therefore, we are of the opinion that it is important to assess and interpret hip BMD, clinical fracture risk factors and bone quality components in these patients. Osteoporosis is a factor that increases the risk of fractures. Randomized prospective studies in larger clinical series are needed for the generalization of these results.

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