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Evaluation of Vertebral Deformations in Women with Osteopenia

Osteopenili Kadınlarda Vertebra Deformasyonlarının Değerlendirilmesi

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Abstract

Objective: The extent to which vertebral integrity is affected in patients with osteopenia was investigated in this study.
Materials and Methods: We included 304 female patients aged between 40 and 74 and treated in the internal medicine outpatient clinic of a secondary healthcare institution. Total lumbar T and Z-scores and femoral neck T and Z-scores were analyzed by dual-energy X-ray absorptiometry. We included patients with a T-score between -1 and -2.4 and evaluated the thoracic and lumbar vertebrae of the patients with dorsal and ventral X-ray imaging. We examined whether the patients had vertebral fractures and if so, we determined the fracture level.
Results: The vertebral fracture was found in 30.6% of the patients, and the frequency of scoliosis in these patients was found to be higher than those without fractures ($p<0.001$). There was a significant correlation between the frequency of vertebral fractures and the number of years that passed after menopause ($p<0.001$). When the premenopausal and postmenopausal periods were compared, a significant increase was observed in the menopausal threshold and the frequency of fractures ($p=0.036$). Body mass index (BMI) levels were found to be significantly higher in patients with fractures ($p=0.001$). No significant correlation between the lumbar T-score and the frequency of vertebral fractures ($p=0.469$) and the frequency of scoliosis ($p=0.116$) was found.
Conclusion: The time elapsed after menopause increases the frequency of fractures. Contrary to the general literature, our study showed an increase in the frequency of fractures with obesity and increased BMI. When we scanned 304 osteopenic patients with X-rays, we found a significant frequency of fractures, but the fractures of most patients were 'silent.' Although osteopenia is common in the community, as in the literature, our study also shows that these patients should be examined in terms of vertebral fracture even if they do not have any symptoms.
Keywords: Osteopenia, elderly women, vertebrael deformation, scoliosis

Öz

Amaç: Bu çalışmada osteopenili hastalarda vertebra bütünlüğünün ne ölçüde etkilendiği araştırıldı.
Gereç ve Yöntem: Çalışmaya ikinci basamak bir sağlık kuruluşunun iç hastalıkları polikliniğinde tedavi gören 40-74 yaş arası 304 kadın hasta dahil edildi. Total lomber T ve Z-skorları ile femur boyun T ve Z-skorları çift enerjili X-ışını absorbsiyometri ile analiz edildi. T-skoru -1 ile -2,4 arasında olan hastaları dahil edildi ve dorsal ve ventral X-ışını görüntüleme ile hastaların torasik ve lomber vertebraları değerlendirildi. Hastalarda vertebra kırığı olup olmadığı incelendi ve varsa kırık şiddeti belirlendi.
Bulgular: Hastaların %30,6'sında vertebra kırığı saptandı ve bu hastalarda skolyoz sıklığı kırık olmayanlara göre daha yüksek bulundu ($p<0,001$). Omurga kırıklarının sıklığı ile menopozdan sonra geçen yıl sayısı arasında anlamlı bir ilişki vardı ($p<0,001$). Premenopozal ve postmenopozal dönemler karşılaştırıldığında menopoz eşiğinde ve kırık sıklığında anlamlı artış görüldü ($p=0,036$). Vücut kitle indeksi (VKİ) düzeyleri kırıklı hastalarda anlamlı olarak yüksek bulundu ($p=0,001$). Lomber T-skoru ile vertebral kırık sıklığı ($p=0,469$) ve skolyoz sıklığı ($p=0,116$) arasında anlamlı bir ilişki bulunmadı.
Sonuç: Menopoz sonrası geçen süre kırık sıklığını artırmaktadır. Genel literatürün aksine, çalışmamız obezite ve artmış VKİ ile kırık sıklığında artış göstermiştir. Üç yüz dört osteopenik hastayı direkt radyografi ile taradığımızda, önemli bir kırık sıklığı bulduk, ancak çoğu hastanın kırıkları "sessiz" idi. Toplumda osteopeni sık görülmekle birlikte literatürde olduğu gibi çalışmamız da bu hastaların herhangi bir semptomu olmasa bile vertebra kırığı açısından incelenmesi gerektiğini göstermektedir.
Anahtar kelimeler: Osteopeni, ileri yaş kadın hasta, vertebral deformasyon, skolyoz

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Introduction

Osteopenia defines the decrease of T-score level and bone mineral density (BMD) in dual-energy X-ray absorptiometry (DXA). The World Health Organization (WHO) defines a T-score between -1 and -2.5 as osteopenia, values less than -2.5 as osteoporosis. Osteopenia is a "pre-diagnosis" for osteoporosis. With the aging of the population and the prolongation in life expectancy worldwide, osteoporosis and osteopenia are considered as a more serious health problem. In the FRACTURK (1) study, the prevalence of osteoporosis in our society was 25% over the age of 50, while the prevalence of osteopenia was 50%. While the prevalence of osteoporosis was evaluated as 14.9% in patients undergoing lumbar fusion surgery, it was shown in a study that the prevalence of osteopenia was 43.6% (2). If necessary precautions are not taken in patients with osteopenia, progression to osteoporosis is inevitable and decreased bone density is a major risk factor for fragility fracture (3,4). Osteopenia and osteoporosis are "silent" until a fracture occurs, they are mostly asymptomatic in this period, and in case of fracture, they create an economic burden in terms of both the cost of the fracture and the complications (5,6). While the cost of fragility fractures was $19 billion in 2005 in the United States, direct and indirect care activities are expected to exceed $25 billion in 2025 (7).

Fragility fractures are fractures that occur as a result of mechanical force, known as a trauma with too low energy to normally cause a fracture. The mentioned mechanical power is the force equivalent to falling at a standing distance according to the WHO (8). Some of the fractures that develop due to these conditions such as osteopenia and osteoporosis are "silent" and could be detected incidentally on imaging. Just like in osteoporosis, osteopenia has been shown to increase the risk of high fracture in many studies. Especially in elderly women, the risk of osteoporotic fracture is high, as well as the risk of osteopenic fracture. Vertebral fractures can cause kyphosis, thoracic deformities and scoliosis. Asymptomatic vertebral fractures are also a well-known risk factor for subsequent fractures which may develop (9-11).

Menopausal (hormonal) component of loss of bone mass and early menopausal age are the main factors causing vertebral osteopenia (12). Early menopause is characterized by low bone density in later years and is associated with a higher fracture rate. These women should be evaluated with DXA within 10 years after menopause for early diagnosis of osteoporosis and osteopenia (13). Although it has been shown that the risk of idiopathic osteoporotic fracture increases significantly at the T-score of -2.5 threshold (14), the OFELY study showed that the risk of fracture is higher when the T-score is -2 and above (15).

The prevalence of scoliosis in adults varies between 1% and 10% (16,17). Deformity that develops later in adults is seen in more than 30% of elderly patients without spinal anomaly. Adult degenerative scoliosis is typically diagnosed in patients older than 40 years of age and without a history of adolescent scoliosis (18). There are studies in which osteopenia is thought to play a role in increasing the scoliosis slope (18,19).

Purpose of the Study

In some of the patients with osteopenia, degeneration develops in the thoracic and lumbar vertebrae, in our study, we planned to investigate how many fractures were detected in the patients and the degree of these fractures and we also planned to evaluate whether thoracic, lumbar, or thoracolumbar scoliosis accompanies vertebral degeneration and fractures and to observe the frequency of kyphosis and scoliosis in cases of osteopenia. This study plans to evaluate how much awareness should be taken about BMD examination and fracture risk in patients with scoliosis and kyphosis. We planned to assess the correlation of vertebral deformities with the lumbar T-score evaluated in DXA and at the same time, it will be evaluated whether there is a relationship between patient age, time passed after post-menopause, patient height and fracture risk, and whether there is a significant relationship on the effect of body mass index (BMI) on fractures. Some of the patients in the study are in the pre-menopausal period and crossing the menopausal threshold will also investigate whether there is an increase in the incidence of fracture. As a result of all these findings, the need for antiresorptive treatment in osteopenic patients will be evaluated indirectly as a result of our study.

Materials and Methods

We included 304 female patients aged between 40 and 74 treated in the internal medicine outpatient clinic of a secondary health care institution. Total lumbar T and Z-scores and femoral neck T and Z-scores were analyzed by DXA. We included patients with a T-score between -1 and -2.4 and evaluated the thoracic and lumbar vertebrae of the patients with dorsal and ventral X-ray imaging. We examined whether the patients had vertebral fractures and if so, we determined the fracture level. We used the criterion by which Genant et al. (20) categorized vertebral fractures by fracture level. The mild fracture is characterized by the concavity of the vertebra and evaluated as stage 1 fracture, the moderate fracture is characterized by wedging of the vertebra and evaluated as a stage 2 fracture, and the severe fracture is characterized by vertebral crushing and collapse and is evaluated as a stage 3 fracture (20). It was planned to evaluate the patients in terms of scoliosis and kyphosis, as well as vertebral fractures, to determine whether deformations accompany each other in their fractures. The patients were evaluated in terms of thoracic and thoracolumbar scoliosis, and the presence of scoliosis of 5 or more degrees was evaluated as scoliosis. The presence of compensatory curvature was excluded from the study. Case with a history of childhood and adolescent were excluded from the study. We excluded patients who exceeded the osteoporosis threshold and had a T-score of -2.5 and above. Patients with hyperthyroidism, type 1 diabetes mellitus, rheumatic disease, Celiac disease and patients using chronic steroids were excluded from the study. The height,

weight and BMI of the patients were also included in the study, and how height-weight and BMI increases and decreases affected the osteopenia status was examined. The incidence of vertebral fractures in postmenopausal women and women who have not yet developed menopause was investigated. In our study, we examined whether the number of years passed in the postmenopausal period in women in the postmenopausal period caused an increase in the level of fractures and in the level of scoliosis and kyphosis. Vertebral morphological evaluation was made by the primary investigator and only vertebral fractures were evaluated within the scope of the study, and the presence of non-vertebral fractures was not included in the study.

In our study, informed consent was obtained from the patients. Ethics committee approval with decision number 2021/514/200/2 was obtained from Kartal Dr. Lütfi Kırdar City Hospital (date: 28.04.2021).

Statistical Analysis

Statistical analyses used the Number Cruncher Statistical System (NCSS) program. Descriptive statistics of the data obtained were calculated as arithmetic mean, standard deviation, median value, first (25^{th}) and third quartile (75^{th}) (interquartile range =75^{th}-25^{th}), absolute and relative frequencies, depending on the type and distribution of the characteristics and were summarized in tables. The suitability of the numerical type characteristics to the normal distribution was examined using the Shapiro-Wilks test. Non-parametric tests were used for non-normally distributed characteristics. Relationships between categorical characteristics were compared with Pearson chi-square or Fisher-Freeman-Halton test. Mann-Whitney U test, Independent samples t-test, Kruskal-Wallis test or One-Way ANOVA model were used in the comparison of groups in terms of numerical characteristics by considering the distribution of numerical characteristics and the number of groups. Information about which test is used for which purpose is written under the tables. In addition, correlations between numerical type characteristics were examined by Spearman's rank correlation analysis. Statistical significance level was accepted as $p<0.05$ and SPSS (ver. 25) program was used for calculations.

Results

A total of 304 patients were included in our study. The mean age of the patients was 57 years. Of all the patients, only 28 were in pre-menopausal period and 276 were in postmenopausal period. A total of 93 (30.6%) patients had vertebral fractures, 32 patients had 1^{st} degree fracture (concavity) (34.4%), 25 patients had 2^{nd} degree fracture (wedging) (26.9%), 36 patients had 3^{rd} degree fracture (collapse fracture) (38.7%). Scoliosis was observed in 122 (40%) patients and thoracic kyphosis was observed in 40 (13.2%) patients.

Descriptive statistics of numerical type measurements performed on patients are presented in Table 1.

The distributions of the categorical characteristics of the patients are presented in Table 2. When Table 2 is examined, it is seen that the rate of postmenopausal patients is 90.8%, the frequency of fractures is 30.6%, the frequency of scoliosis is 40.1% and the frequency of kyphosis is 13.2%.

As a result of vertebral morphology, the frequency of scoliosis was found to be significantly higher in patients with first, second and third degree fractures than those with normal vertebral morphology (Table 3, $p<0.001$). However, no significant difference was found between grades ($p=0.254$).

The frequency of scoliosis obtained when the patients were divided into two groups as with and without fracture according to their vertebral morphology by disregarding the degree of fracture is presenting in Table 4. When the table was examined, it was seen that the frequency of scoliosis was significantly higher in patients with fractures (62.4%) than in patients without fractures (30.3%) ($p<0.001$).

No significant correlation was found between the degree of fracture and the degree of scoliosis ($r=-0.47$, $p=0.726$). According to this result, it can be said that there will be no significant change in the direction of increase or decrease in the degree of scoliosis as the degree of fracture increases.

When the patients with and without fractures were compared in terms of the degree of scoliosis, the results presented in Table 5 were obtained. When the table is examined, the rate of those with a scoliosis grade of "5" was significantly higher in those without fractures, while the rate of those with a scoliosis grade of "20" and "30" in those with fractures was significantly higher

Table 1. Descriptive statistics of numerical characteristics

	n	Mean	SD	Percentiles		
				25^{th}	Median	75^{th}
Age	304	56.97	6.822	52.00	56.00	61.00
Menopause age	276	46.36	5.238	44.00	47.00	50.00
Menopause duration	276	11.45	8.030	5.25	10.00	16.00
Lumbar T osteopenia	304	-1.390	0.6580	-1.900	-1.400	-1.000
Height (cm)	304	154.67	5.570	151.00	155.00	158.00
Weight (kg)	304	76.03	12.140	67.00	75.00	83.00
BMI	304	31.41	5.366	28.00	31.00	34.00

BMI: Body mass index, SD: Standard deviation

(p<0.001). On the other hand, the rate of those with scoliosis grade "10" and "15" was similar in those with and without fractures.

The relationship between lumbar T-score and vertebral fracture is summarized in Table 6. When the table was evaluated, it was seen that there was no significant difference between vertebral fracture results in terms of lumbar T-score (p=0.469).

When the relationship between the presence of vertebral fracture and the number of years after menopause was examined, it was observed that the duration of menopause was significantly longer in those with fractures (Table 7, p<0.001). However, no significant relationship was found between duration of menopause and the degree of fracture (r=-0.053, p=0.619).

Fracture was observed in only 4 (14.3%) of 28 pre-menopausal patients. When 28 pre-menopausal patients and 276 menopausal patients were compared in terms of fracture frequency, it was determined that the frequency of fracture was significantly higher in the postmenopausal period (p=0.036, Table 8).

When the degree of fracture was compared in people with pre-menopausal and postmenopausal fractures, it was determined that the frequency of first-degree fractures was significantly higher in the premenopausal group, and the frequency of third-

Table 2. Descriptive values for the categorical characteristics of the patients

		n	%
Menopause status	Pre-menopause	28	9.2
	Menopause	276	90.8
Vertebral morphology	Normal	211	69.4
	1st degree, concave	32	10.5
	2nd degree, cuneiform	25	8.2
	3rd degree, crush	36	11.8
Fracture	None	211	69.4
	Present	93	30.6
Degree of fracture	1st degree	32	34.4
	2nd degree	25	26.9
	3rd degree	36	38.7
Scoliosis	None	182	59.9
	Present	122	40.1
Degree of scoliosis	5	38	31.1
	10	54	44.3
	15	12	9.8
	20	14	11.5
	30	4	3.3
Kyphosis	None	264	86.8
	Present	40	13.2
Obesity	Normal	22	7.2
	Overweight	88	28.9
	Obese	194	63.8

Table 3. The relationship between the degree of vertebral fracture and the presence of scoliosis

		Vertebral morphology*, **								Total
		Normal		1st degree, concave		2nd degree, cuneiform		3rd degree, crush		
		n	%	n	%	n	%	n	%	n
Scoliosis	None	147	69.7	14	43.8	6	24.0	15	41.7	182
	Present	64	30.3	18	56.3	19	76.0	21	58.3	122
Total		211		32		25		36		304

*Pearson chi-square test. **Each subscript letter denotes a subset of vertebra morphology categories whose column proportions do not differ significantly from each other at the 0.5 level

degree fractures was significantly higher in the postmenopausal group (p=0.050, Table 9).

There was no significant difference in fracture frequency between patients shorter and taller than 160 cm (p=0.125, Table 10).

Of the 93 people with fractures, 82 (88.17%) were shorter than 160 cm, while the rest were 160 cm or taller. The frequency of second-degree fractures in patients shorter than 160 cm and third-degree fractures in patients with a height of 160 cm and above was found to be significantly higher (p=0.050, Table 11).

Mean height was found to be significantly shorter in patients with fractures (p=0.030, Table 12).

The mean BMI was found to be significantly higher in patients with fractures (p=0.001, Table 13).

In addition, no statistically significant relationship was found between the degree of fracture and BMI (r=-0.158, p=0.131).

When the obesity groups were compared in terms of fracture frequency, it was determined that the fracture frequency was significantly higher in the obese than the other two groups (normal and overweight) (p=0.004, Table 14).

Table 4. The relationship between the presence of fracture and the frequency of scoliosis

		Fracture*				
		None		Present		
		n	%	n	%	n
Scoliosis	None	147	69.7	35	37.6	182
	Present	64	30.3	58	62.4	122
Total		211		93		304

*Pearson chi-square test.

Table 5. The relationship between the presence of fracture and the degree of scoliosis (thoracic, thoracolumbar)

		Fracture*, **				Total
		None		Present		
		n	%	n	%	n
Degree of scoliosis	5	26	40.6	12	20.7	38
	10	33	51.6	21	36.2	54
	15	5	7.8	7	12.1	12
	20	0	0.0	14	24.1	14
	30	0	0.0	4	6.9	4
Total		64		58		122

*Pearson chi-square test. **Each subscript letter denotes a subset of vertebra morphology categories whose column proportions do not differ significantly from each other at the 0.5 level

Table 6. Descriptive values of lumbar T-score according to vertebral fracture results

Vertebral morphology	n	Mean	SD	Percentiles		
				25th	Median	75th
Normal	211	-1.382	0.6564	-1.900	-1.400	-1.000
1st degree, concave	32	-1.450	0.6525	-1.875	-1.500	-1.125
2nd degree, cuneiform	25	-1.468	0.8112	-2.100	-1.600	-1.100
3rd degree, crush	36	-1.328	0.5675	-1.775	-1.300	-.850

*Kruskal-Wallis test, SD: Standard deviation

Table 7. Descriptive values of duration of menopause according to the presence of vertebral fracture

Fracture	n	Mean	SD	Percentiles		
				25th	Median	75th
None	187	10.15	7.367	5.00	9.00	14.00
Present	89	14.19	8.697	7.50	12.00	17.00

*Mann-Whitney U test

Table 8. The relationship between the development of menopause and the frequency of fractures

		Menopause status*, **				Total
		Pre-menopause		Menopause		
		n	%	n	%	n
Fracture	None	24	85.7	187	67.8	211
	Present	4	14.3	89	32.2	93
Total		28	100.0	276	100.0	304

*Pearson chi-square test
**Each subscript letter denotes a subset of vertebra morphology categories whose column proportions do not differ significantly from each other at the 0.5 level.

Table 9. The relationship between menopausal status and degree of fracture

		Menopause status*, **				Total
		Pre-menopause		Post-menopause		
		n	%	n	%	n
Degree of fracture	1st degree	1	25.0	31	34.8	32
	2nd degree	3	75.0	22	24.7	25
	3rd degree	0	0.0	36	40.4	36
Total		4	100.0	89	100.0	93

*Pearson chi-square test. **Each subscript letter denotes a subset of vertebra morphology categories whose column proportions do not differ significantly from each other at the 0.5 level

Table 10. The relationship between height and frequency of fracture

		Height groups*				Total
		<160 cm		≥160 cm		
		n	%	n	%	n
Fracture	None	171	67.6	40	78.4	211
	Present	82	32.4	11	21.6	93
Total		253	100.0	51	100.0	304

*Pearson chi-square test

Table 11. The relationship between height and degree of fracture

		Height groups*, **				
		<160 cm		≥160 cm		
		n	%	n	%	n
Degree of fracture	1st degree	30	36.6	2	18.2	32
	2nd degree	19	23.2	6	54.5	25
	3rd degree	33	40.2	3	27.3	36
Total		82		11		93

*Fisher-Freeman-Halton test. **Each subscript letter denotes a subset of vertebra morphology categories whose column proportions do not differ significantly from each other at the 0.5 level

Table 12. Descriptive values for height in patients with and without fractures

	Fracture	n	Mean	SD	p*
Height (cm)	None	211	155.13	5.545	0.030
	Present	93	153.62	5.515	

*Independent samples t-test. SD: Standard deviation

Table 13. BMI averages in people with and without fractures

Fracture	n	Mean	SD	Percentiles			p
				25th	Median	75th	
None	211	30.69	5.022	27.00	30.00	33.00	0.001
Present	93	33.05	5.774	29.50	32.00	36.00	

Independent samples t-test. SD: Standard deviation

Table 14. Fracture frequency of obesity groups

		Obesity						Total
		Normal		Overweight		Obese		
		n	%	n	%	n	%	n
Fracture	None	19	86.4	70	79.5	122	62.9	211
	Present	3	13.6	18	20.5	72	37.1	93
Total		22		88		194		304

Pearson chi-square test, each subscript letter denotes a subset of vertebra morphology categories whose column proportions do not differ significantly from each other at the 0.5 level

Discussion

Osteoporotic fractures may also occur in osteopenic patients (21), and while the rate of vertebral fractures in women over 50 years of age is between 20-30% in the general population, this rate is 40% over the age of 80 (22,23). Vertebral fracture rate was detected as 26.5% in osteopenic asymptomatic elderly men and postmenopausal women in Vietnam (24), 9.5% in osteopenic old men and postmenopausal women in Japan (25), and 29% in Thai postmenopausal healthy osteopenic women and 62% of these fractures were graded as grade 1, 19.3% as grade 2, and 18.7% as grade 3. It was observed that 4.9% of patients with fractures were under the age of 50, and the remaining patients were over the age of 50 (26). In our study, fractures were detected in the thoracic or lumbar vertebrae in 30% of the patients, and a similar vertebral fracture rate was found in the study conducted in Thailand. First degree fracture (concavity) was observed in 30% of the patients, 2nd degree fracture (wedge) in 26%, and 3rd degree fracture (collapse fracture) in 38% of the patients. In the International Society for Clinical Densitometry 2019, it was stated that it should be questioned and evaluated whether there is a history of vertebral fracture in patients with a shortening of 4 cm or more in length in those with a T-score of -1 and below (27).

Urritia et al. (28) found a 12.9% lumbar scoliosis prevalence in postmenopausal women over 50 years of age and showed a positive correlation between BMI and age and scoliosis prevalence, but showed that BMD was not indicative for scoliosis. Rozenberg et al. (29) showed a 30% correlation between lumbar BMD and vertebral deformities and degenerative lesions; Spencer et al. (30) showed 11% , and Sahota et al. (31) showed this rate as 81%. In our study, no correlation was found between the degree of lumbar T-score and the presence of vertebral fracture (Table 6, p=0.469). Scoliosis was detected in 40% of our cases, and kyphosis in 13% of our cases, and the scoliosis slope was 10 degrees or less in 75% of patients with scoliosis. Severe scoliosis slope of 20 degrees or more was observed in 14.8% of them. As seen in Table 3, no significant correlation could be found between the lumbar T-score and the presence of scoliosis (p=0.925). As seen in Table 4, there was no significant relationship between BMD and scoliosis, as in the study of Urritia et al. (28) between the lumbar T-score and the degree of scoliosis slope (p=0.116).

The frequency of scoliosis was found to be significantly higher in patients with vertebral fractures compared to patients without fractures (Table 3, p<0.001), but no correlation could be detected between the degree of fracture and the degree of scoliosis (Table 4, p<0.001). In patients with no vertebral fracture, scoliosis slope of 5 degrees, which is not clinically significant, was more common in the presence of scoliosis, while the degree of slope was more pronounced in the group with vertebral fracture, and high slopes such as 20-30 degrees were found to be higher in this group (Table 5, p<0.001).

Only 22 of the cases had a normal BMI, while 88 of the remaining patients were overweight and 194 were obese. In the literature, it has been shown that low BMI is associated with an increase in fragility fracture (32), on the contrary, in our study, 20% of the patients with a BMI below 30% had a vertebral fracture, while this rate was 36% in patients with a BMI of 30% and above. While the BMI values were found to be higher in patients with fractures (Table 13, p=0.131), the frequency of fractures was also higher in obese individuals (Table 14, p=0.004).

While 14% of osteopenic patients had vertebral fractures in the pre-menopausal period, this rate was 32% in post-menopausal women, and a significant difference was observed. (Table 8, p=0.036) While the most commonly 1st degree fracture is detected in patients with pre-menopausal vertebral fractures, this rate is in favor of 3rd degree fractures in postmenopausal

women. In one study (33), increase of the incidence of fractures was shown as the number of years passed after menopause increased. In our study, the rate of vertebral fracture was 32.6% in the group with less than 10 years of postmenopausal years, 63.8% in patients with a postmenopausal year between 10-19 years, and this rate was 83.3% in patients with a postmenopausal year of 20 years or more. While a significant relationship was shown between the number of years passed after menopause and the frequency of vertebral fractures, there was no relationship between the degree of fracture and the number of years after menopause (Table 7, p<0.001).

In our study, the average height was 154 cm, and although no correlation could be shown between height and the frequency of vertebral fractures (Table 10, p=0.125), when 93 people with vertebral fractures were examined, it was observed that 88% were below 160 cm and 12% were 160 cm and above (Table 11, p=0.050). Vertebral fracture rate is 21.5% in patients with a height of 160 cm and above, and the fracture rate is 32.4% in individuals under 160 cm. When the 2 groups with and without vertebral fracture were compared, we found that the mean height was shorter in the group with vertebral fracture (Table 12, p=0.030). In patients with vertebral fractures, short stature may be the first complaint due to unrecognized vertebral fractures. In case of multiple fractures, kyphosis may develop. Although kyphosis is not diagonal for osteoporosis (there also may be kyphosis with normal bone density), kyphosis may develop in case of excessive vertebral fractures (34). In the Spanish guidelines, radiological imaging of the vertebrae of osteopenic patients with shortening is recommended (35), and in Canadian guidelines, it is recommended to evaluate the number of falls annually in addition to vertebral imaging in the presence of shortened height (36).

Also in the OFELY study (159, 8% of 116 women with fractures were normal, 44% were osteoporotic, while 48% of the patients were found to be osteopenic, and it was shown in the study that the incidence of fracture in the osteopenic group was as high as the osteoporotic group. Fifty of a total of 158 fractures were shown only in the vertebrae, and it was determined that the incidence of fractures in the osteopenic group increased gradually over the next 10 years. There are also studies (5) showing micro-damages in osteopenia apart from visible fractures in the vertebrae. Advanced examinations such as peripheral quantitative computed tomography, quantitative ultrasonography are able to examine the trabecular structure of bones in low bone mineral densitometry (37) and detect microfractures (38). In the OSTEOXPRESS study, in which vertebral deformities were evaluated using MorphoXpressSR software, postmenopausal osteopenic defined lumbar vertebral fracture rate of 7% (by X-ray) was found to be 50% (39). Although vertebral fractures are often overlooked in asymptomatic patients (40,41). X-ray is still a very useful imaging method in asymptomatic or symptomatic osteopenic patients (11). The IMPACT study, a multicenter study, evaluated the radiographic diagnosis of vertebral fractures in 2,451 postmenopausal women with osteoporosis. Comparisons between local and central readings showed a false-negative rate of 34% (42). In another study, 28% silent fractures were detected with X-ray in asymptomatic postmenopausal women with X-ray imaging. Although we did not have the opportunity to reach further examinations in which we could evaluate the lumbar and thoracic vertebral integrity, except for X-ray, in the 2nd stage working conditions, we still detected vertebral fractures at varying levels in 30% of 304 osteopenic patients with X-ray, at similar rates to this study (43). We think that the true fracture rate is much higher in micro-fractures that cannot be detected. Considering that a single vertebral fracture increases the risk of subsequent hip fracture by 5 times and the risk of fractures in other bones by 2-3 times (44), the importance of imaging becomes evident in osteopenic patients, even if it is clinically silent. These patients need anti-resorptive treatment and if they are treated, comorbidity is prevented and the rate of progression to osteoporosis slows down. In a study conducted in Australia, it was shown that detecting and treating osteopenicpatients provides an annual cost-effectiveness of $4,992 per patient and $6,135 per year whenbased on quality of life (45). Although osteopenia, osteoporosis, which is a step forward, fractures that develop in various parts of the body, such as the vertebral and femoral head, and various morbidity and mortality caused by these fractures create a financial burden both individually and socially, in case of osteopenia is detected at an early stage, evaluated for the presence of fracture, and if the presence of fracture is detected, initiation of antiresorptive therapy and oral calcium replacement is incomparably more cost-effective considering the aging of the population and the increase in comorbidities from year to year. When all these come together, X-ray imaging of the patient group in whom we have detected osteopenia is still very valuable, and we think that thoracic and lumbar vertebral graphs should be evaluated in order to detect silent fractures and in case of the presence of fracture, that X-ray imaging is important for the regulation of antiresorptive treatment and stabilization of the fracture.

Conclusion

Patients with a diagnosis of osteoporosis need anti-resorptive therapy, as well as patients with a diagnosis of osteopenia need antiresorptive therapy in case of fractures. The axial skeleton is more vulnerable to external influences than the extremity bone tissue due to its smaller size, irregular bone structure and semi-mobile structure compared to other bone structures. While fractures in cortical bone tissue are more easily evaluated, it is almost impossible to evaluate micro-fractures in trabecular bone tissue via direct graphs. The fractures that we could detect in our study data were cortical bone fractures, and we think that they may be in trabecular fractures that we could not detect. Although we expect an increase in this number in case of the presence of fractures is investigated with further investigations, we think that it is necessary to examine the thoracic and lumbar

vertebrae at least by X-ray imaging of patients with osteopenia that detected by DXA and to initiate treatment if fractures are detected. In case of the patient had osteopenia and we detected a fracture, the cost of treatment of patients who are not treated and progressed to osteoporosis, the cost-effectiveness of complications secondary to osteoporosis and even the loss of labor are too high to accept when compared to the cost of treatment of patients we apply anti-resorptive treatment. If the patients with the current clinic are treated appropriately, we avoid the mortality and morbidity of osteoporosis and its complications.

Ethics

Ethics Committee Approval: This study was approved by the Kartal Dr. Lütfi Kırdar City Hospital Clinical Research Ethics Committee (decision no: 2021/514/200/2, date: 28.04.2021).

Informed Consent: In our study, informed consent was obtained from the patients.

Peer-review: Externally peer-reviewed.

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