



# VERTEBROPLASTY FOLLOWING VERTEBRAL COMPRESSION FRACTURE IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS

## KRONİK TIKAYICI AKCİĞER HASTALARININ OMURGANIN ÇÖKME KIRIKLARINDA VERTEBROPLASTİ UYGULAMALARI

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### SUMMARY:

**Objective:** The aim of this study was to demonstrate the appropriateness and efficacy of vertebroplasty application in patients who developed osteoporotic vertebral compression fracture (OVCF) during their chronic obstructive pulmonary disease (COPD) treatment.

**Patients and Methods:** Nine patients who underwent vertebroplasty between 2003 and 2013 due to vertebral compression fractures developed during their COPD treatment, received pulmonary function tests (PFT) pre- and postoperatively, and had a minimum follow-up period of 6 months were included in the study. Patients' VAS scores, respiratory parameters, vital capacity percentages (VC %), forced vital capacity percentages (FVC %) and forced expiratory volume in 1 second (FEV1 %) were measured.

**Results:** Patients presented to our clinic with an increase in shortness of breath, and waist and back pain. The average time between the onset of symptoms and surgery was 31.3 days. Patients' preoperative mean VAS score was 9 whereas it was noted 2 on the postoperative first day, 1.9 at the 1st month and 1.6 at the 3rd month follow-ups. A significant difference was detected between the preoperative and postoperative VAS scores ( $p<0.01$ ). However, no significant difference was found between the VAS scores measured at follow-up visits. The average time between the surgery and PFT was 54 days. Patients' FVC developed from 58 to 64% ( $p<0.05$ ), predicted FEV1 from 59 to 62% ( $p<0.05$ ), and the (FVC/pred. FVC) ratio from 101.7 to 107.4% ( $p<0.05$ ).

**Conclusion:** Vertebroplasty is an effective method in treatment of COPD patients with osteoporotic compression fractures. One should not insist to wait for the results of the three-month conservative treatment period before considering a surgical intervention for patients who developed COPD and OVCF.

**Keywords:** Chronic obstructive pulmonary disease; compression fracture; vertebroplasty.

**Level of Evidence:** Retrospective Clinical Study, Level III

### ÖZET:

**Giriş:** Bu çalışmanın amacı kronik obstrüktif akciğer hastalığı (KOAH) tedavisi alırken ve osteoporotik vertebra çökme kırığı gelişen hastalarda vertebroplastinin yeri ve etkinliğini göstermektir.

**Materyal Metod:** Çalışmaya 2003-2013 yılları arasında KOAH tanısı ile tedavi alırken gelişen vertebra çökme kırığı sebebiyle vertebroplasti yapılmış, ameliyat öncesi ve sonrası solunum fonksiyon testi (SFT) yapılmış ve en az 6 ay takip edilen 9 hasta çalışmaya dahil edildi. VAS skorları ve respiratuar parametreleri; Vital kapasite yüzdesi (%VC), zorlu vital kapasite yüzdesi (%FVC) ve bir saniyedeki zorlu ekspiratuar hacim yüzdesi (%FEV1) elde edildi.

**Sonuçlar:** Hastaların hastaneye başvuru sebepleri daha önceden var olan nefes darlığı şikayetinin artışına ek olarak sırt ve bel ağrısı olarak saptandı. Şikayetlerin başlamasıyla operasyon arasında geçen süre 31.3 gün olarak bulundu. Ortalama preop VAS skoru 9 postop 1. günde 2, 1. ayda 1.9 ve 3. ayda 1.6 ise olarak saptandı. Ameliyat öncesi VAS skoru ile ameliyat sonrası arasındaki fark anlamlı bulunurken ( $p<0,01$ ) ameliyat sonrası takipler ki VAS skorları arasında fark bulunmadı. Ameliyat ile solunum fonksiyon testi yapılması arasındaki süre 54 gün olarak bulundu. Hastaların yapılmış olan solunum fonksiyon testlerinin değerlendirilmesinde zorlu vital kapasitelerinin (%FVC) %58 den %64'e ( $p<0,05$ ), 1. Saniye zorlu ekspiratuar hacmi ( $p<0,05$ ) Pred FVC) %59 dan %62'e çıktığı ( $p<0,05$ ), (%FVC)/(Pred FVC) oranı ise 101.7 den 107.4'e ( $p<0,05$ ) çıktığı saptandı

**Tartışma:** Vertebroplasti osteoporotik çökme kırığı olan KOAH hastalarında etkin bir yöntemdir. KOAH olan ve OVÇK gelişen hastalarda cerrahi kararı alınırken 3 aylık konservatif tedavi süresinin beklenmesi konusunda ısrarcı olunmamalıdır.

**Anahtar Kelimeler:** Kronik obstrüktif akciğer hastalığı, KOAH, kompresyon kırığı, vertebroplasti

**Kanıt Düzeyi:** Retrospektif Klinik Çalışma, Düzey III

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## INTRODUCTION:

Osteoporosis is a major problem of morbidity and mortality for the elder population. Compression fractures of the spine are the most commonly encountered type of osteoporosis-related fractures. However, as they present with no symptoms of pain, their diagnosis is often missed. The most common localization of these fractures is the dorsolumbar region. Osteoporotic vertebral compression fractures (OVCF) in the patient group with clinical symptoms cause especially activity-induced pain and have a significant impact on the quality of life of these patients<sup>7,10</sup>. In particular, the impact of this pain on respiratory functions and the efficacy of post-fracture percutaneous vertebroplasty (PVP) on pulmonary capacity in the long-term has been often debated<sup>9,12</sup>. Thirty-six to 60% of the patients with chronic obstructive pulmonary disease (COPD) also suffer from osteoporosis, a prevalence equal to two to five times of those of the same age but has no COPD<sup>3,12</sup>. The real reason to high prevalence of osteoporosis in patients with COPD is unknown, however, parameters such as advanced age, female sex, and body mass index are known to play a role in it.

Chronic obstructive pulmonary disease is a disorder which develops following the obstruction of the airways and caused respiratory problems. Patients with COPD need to use inhaler medications which require deep inhalation. The pain, which gets more significant due to ineffective use of the medications or after the vertebral fracture caused by deep inhalation, will further aggravate the present complications. Moreover, the patients will hardly tolerate the bracing applied for limiting the patients' activities and enabling immobilization.

Our aim in this study was to determine the clinical efficacy of PVP on the treatment of OVCF in patients followed up due to diagnosis of COPD.

## PATIENTS AND METHODS:

Records of 140 patients that underwent PVP due to OVCF between 2003 and 2013 at our institution were found and retrospectively scanned. Medical files of the patients with severe back pain, unresponsive to conservative treatment, and those with a fracture no older than three months were evaluated. Patients with radicular or neurological symptoms, a major trauma, pathological fracture and those with a narrowed spinal canal due to bone fragments were excluded.

Twenty of these patients, diagnosed with COPD by our Department of Respiratory and Pulmonary Diseases and receiving inhaler medication treatment, were enrolled for the study. Of these, nine patients, whose respiratory statuses were checked preoperatively and at least for once in the postoperative three months with pulmonary function tests (PFT) were included in the study. The reason to preoperative PFT was

to prepare the patient for surgery, due to the probability of performance of the surgery under general anesthesia.

Radiological evaluation of the patients with direct radiographs revealed the compression in the spine and the magnetic resonance imaging performed to support this diagnosis confirmed the edema. Osteoporotic statuses of the patients were determined with bone densitometry. Following all clinical and radiological assessments, patients with a vertebral compression fracture on direct radiographs, bone marrow edema in MR findings, and those with no bone fragments in the spinal canal were included in the study.

## Surgical procedure:

All patients were told about the risks and complications of the surgical procedure and their written consents were obtained before surgery. All patients were preoperatively assessed by anesthesiology and other related departments and surgical preparations were completed. Surgery was performed percutaneously as bipedicular vertebroplasty in the supine position and under general or sedation anesthesia combined with local anesthesia. A mean of 1.4 (0.0 to 2) cc of polymethylmethacrylate (PMMA) was injected through each pedicle. All procedures were carried out under fluoroscopic guidance and monitorization of the patient's vitals. Each patient was administered 1 g of cefazolin for antibiotic prophylaxis right before surgery. Patients were closely followed up in the postoperative term and their treatments were planned with analgesics and anti-inflammatory drugs. Patients were neurologically examined after they returned to their beds and were immobilized six hours after surgery. Clinical evaluations of the patients were made on the postoperative first day and at the first and third months.

## Pulmonary function test:

Patients' vital capacity (VC), forced vital capacity (FVC) and forced expiratory volume in 1 second ( $FEV_1$ ) were measured using a computerized spirometer (SensorMedics Vmax Spectra 22; SensorMedics Corp., Yorba Linda, CA, USA) and their respiratory functions were evaluated according to the results in percentage. VC percentages (VC%), FVC percentages (FVC%) and  $FEV_1$  percentages ( $FEV_1\%$ ) were recorded. Pulmonary function test was performed at least three times and the best results for VC, FVC, and  $FEV_1$  according to the American Thoracic Society were noted.

## Statistical analysis:

The visual analog scale (VAS) of 0 to 10 was used in assessment of the severity of pain. A score of 0 meant 'no pain at all' and 10 'the worst pain experienced ever'. Assessments were performed before the PVP surgery, on the postoperative first day, and at the first and third postoperative months. Wilcoxon's

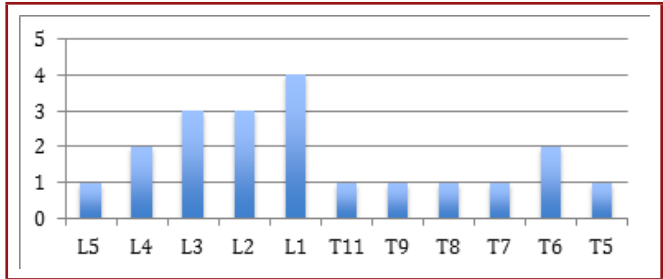
signed-rank test was used in comparing the preoperative and postoperative results for VC, FVC and FEV<sub>1</sub> percentages. Statistical significance level was set at p<0.05.

## RESULTS:

Twenty painful vertebral compression fractures of nine patients (8 females, 1 male; mean age: 62.6, range: 46 to 70 years) were operated in 13 sessions. Levels of the fractured vertebrae are shown in Table 1. Seven patients have been treated with inhaler steroids whereas other two patients have used oral steroids; all for more than a year. The average time between the onset of symptoms and surgery was 31.3 (range: 7 to 62) days. Eight patients (7 females, 1 male) were operated under general anesthesia and one (female) under sedoanalgesia. Five sessions

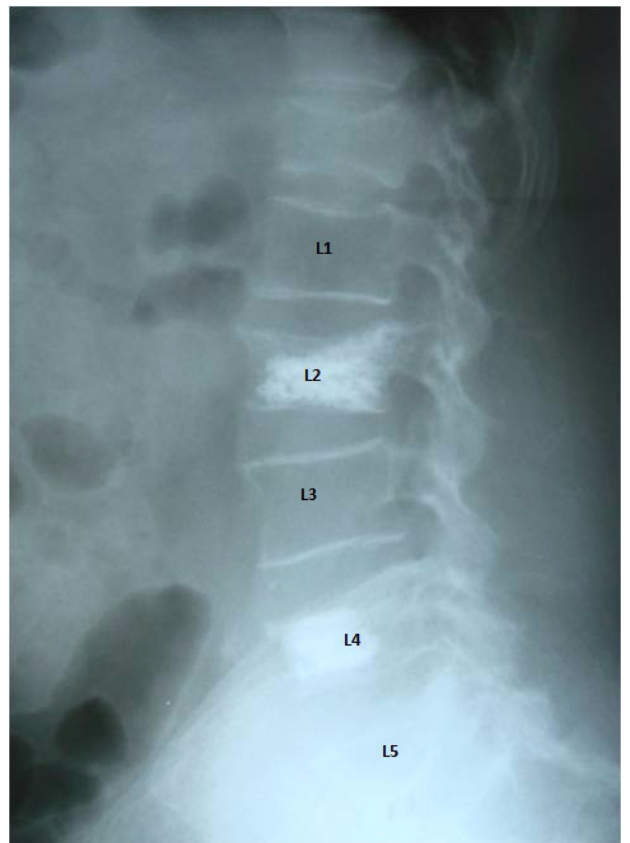
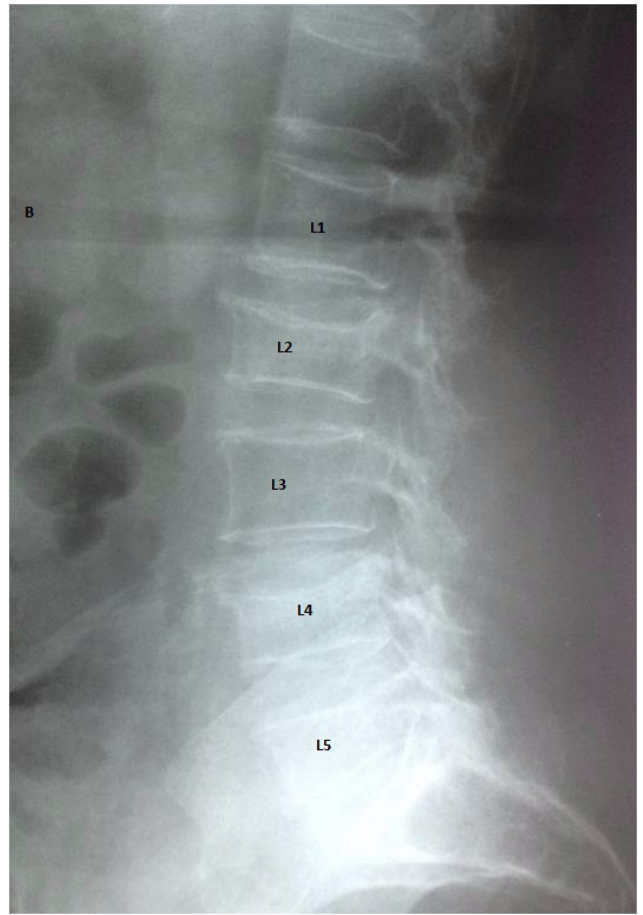
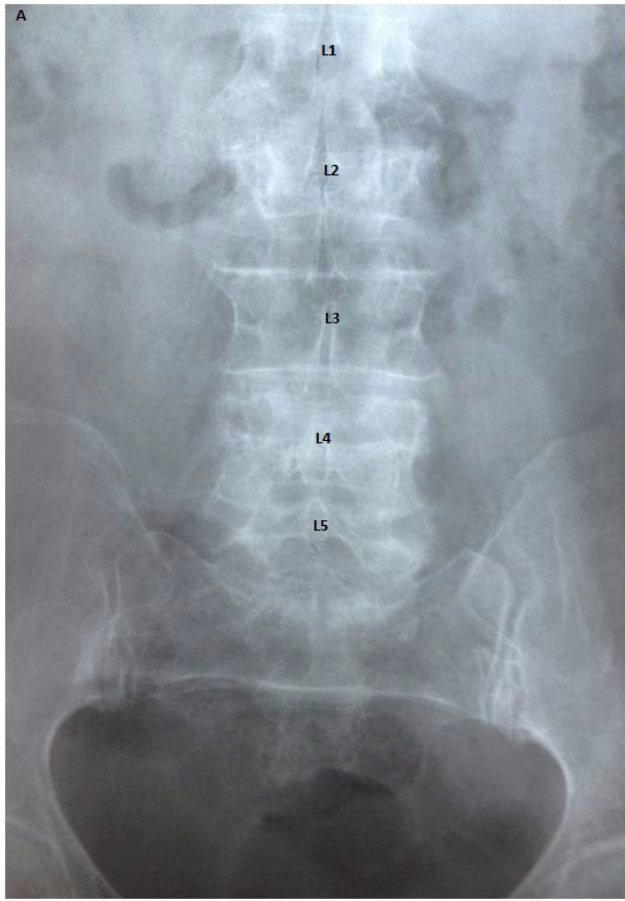
of vertebroplasty had to be performed on eight vertebrae of a 70-year-old female patient at different times throughout a period of four years (Fig. 1).

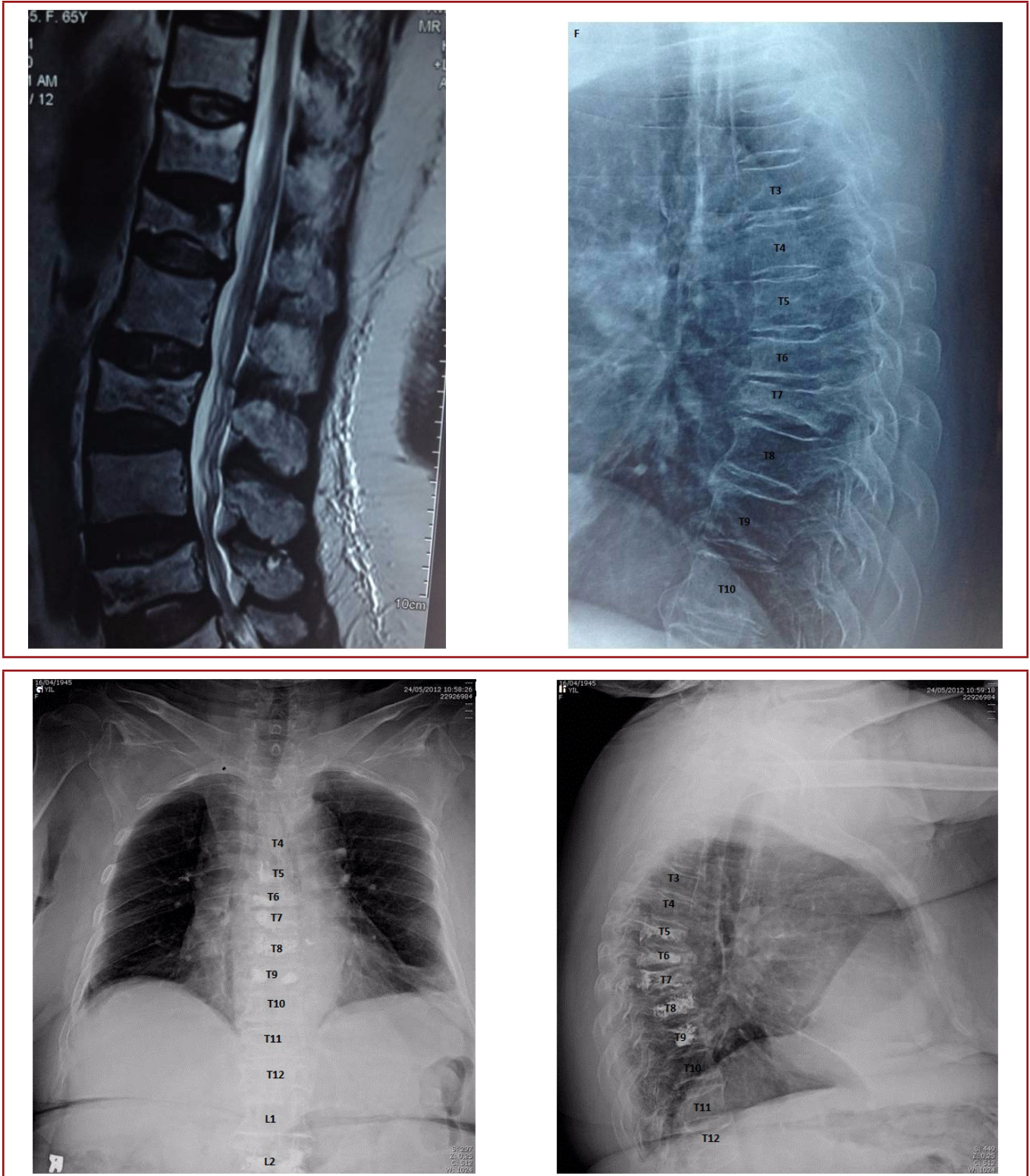
**Table-1.** Localizations of the operated vertebrae.



**Table 2.** List of the patients operated and their results.

Patient no.	1	2	3	4	5	6	7	8	9
Age	70-71-71-72-72	65	46	59	68	52	74	67	63
Sex	F	F	M	F	F	F	F	F	F
Means of steroid use	Inhaler	Inhaler	Inhaler	Oral	Inhaler	Oral	Inhaler	Inhaler	Inhaler
Period of steroid use (years)	8-9-9-10-10	1,5	5	6	3	2,5	4	3	1
Level (in order)	(L2,L4) (T11) (T6,T7) (T9) (T8,T5)	L1	L1, L2	L1, L2, L5	L3	L3, L4	L3	L1	T6
Preoperative VAS score (in order)	8-9-9-9-8	9	10	10	8	9	9	10	9
VAS score on postoperative Day 1 (in order)	2-2-1-1-3	3	3	2	3	2	1	2	2
VAS score at postoperative Month 1 (in order)	2-2-1-1-3	3	2	2	3	2	1	2	1
VAS score at postoperative Month 3 (in order)	2-1-1-2-1	3	2	1	2	2	1	2	1
Time between onset of pain and surgery in days (in order)	28,22,21,10,15	35	58	30	62	30	37	29	40





**Fig. 1.** Images of a 70-year-old female, COPD patient who has been using inhaled glucocorticoids for the last eight years. Vertebral compression fracture at the L2-L4 level can be seen on the (A) anteroposterior and (B) lateral lumbar radiographs. (C) Edema at the L2 and L4 vertebrae on the T2-weighted sagittal MRI. (D) Lateral lumbar radiograph of the patient after PVP surgery. (E) T2-weighted MR image of the T11 vertebra fracture, six months after the primary fracture. (F) Lateral thoracic radiograph and (G) T2-weighted sagittal MR images taken at the first year follow-up. (H) Compression fracture at the T6-T7 vertebral level is seen on the lateral thoracic radiograph of the patient taken at the second year follow-up. (I) Lateral thoracic radiograph of the patient from the final follow-up.

Seven patients (7 females) were performed single-level, five patients (4 females, 1 male) two-level, and one patient three-level vertebroplasty in 13 surgical interventions. Demographic data of the patients are shown in Table 2. Cement leakage into the spinal canal was observed in four vertebrae (20%) of three patients (33.3%), however, no neurological deficit developed. Patients' preoperative mean VAS score was 9 whereas it was recorded as 2 on the postoperative first day, 1.9 at the 1st month and 1.6 at the 3rd month follow-ups. A significant decrease was detected in the postoperative VAS score when compared with the preoperative one ( $p < 0.05$ ). However, no significant difference was found between the VAS scores measured at follow-up visits ( $p > 0.05$ ).

Patients' examinations at initial presentation revealed pain in the fractured vertebral region and shortness of breath. Patients were followed up by the Department of Respiratory and Pulmonary Diseases in the preoperative and postoperative period. The average time between the surgery and PFT was 54 (range: 23 to 89) days. Patients' FVC developed from 58 to 64% ( $p < 0.05$ ), predicted FEV<sub>1</sub> from 59 to 62% ( $p < 0.05$ ), and the (FVC/pred. FVC) ratio from 101.7 to 107.4% ( $p < 0.05$ ).

## DISCUSSION:

Inhalers and oral glucocorticoids are widely used among COPD patients and cause osteoporosis mostly in the spine.<sup>5</sup> The incidence of fractures in this patient group is 20% more when compared with the normal population and the increase is related with the drug dosage and its duration of use.<sup>8</sup> Other predisposing factors such as tobacco use or immobilization are still debated on.<sup>4,11,13</sup> Another matter of controversy is the negative impact of OVCF over respiratory functions<sup>3,6,14</sup>. As the condition inhibits the thoracic mobility and causes postural deformity, the magnitude of such an impact in COPD patients is much higher.<sup>1</sup> Waist and back pain with acute and subacute onsets limit the movement of the thorax, deteriorates the respiratory functions in COPD patients and cause overexertion of the pulmonary muscles<sup>12,14</sup>.

In our study, we investigated the efficacy of vertebroplasty performed on COPD patients with OVCF. The efficacy of the surgical treatment was evaluated using the 11-point VAS and the changes in pulmonary functions were measured using spirometric parameters like FC, FVC and FEV<sub>1</sub>.

Masala et al. observed a progressive increase in VC and FVC values of their PVP patients during the first three preoperative days. The increase reached its plateau after three months and then followed a constant value<sup>9</sup>. The increase in maximal voluntary ventilation (MVV), however, started by the third month. Nevertheless, we should also consider that the patients were given conservative treatment for three months in this study before the authors opted for surgical intervention. In our study, however, we preferred not to wait for this three-month

conservative treatment period as it could affect the patients' quality of life. We also assumed that the wait could aggravate the symptoms especially in COPD patients with reduced pulmonary capacity.

There was a significant correlation between the decrease in VAS scores and the increase in pulmonary function indicators<sup>3</sup>. MVV is an indicator for the endurance of respiratory muscles and inactivity in osteoporotic patients. The decrease in the mobility of the ribs in a typical osteoporotic patient results in a decrease in the endurance of respiratory muscles and strength of isometric muscles, and thus a decline in respiratory functions<sup>2</sup>. VC and FVC values are directly related with the restrictive functions of the lungs and therefore thoracic pain. The analgesic effect of PVP causes an increase in the forced thoracic movement which in turn improves the ventilation in COPD patients. Studies has shown that the only factor that could explain the recovery of respiratory functions is that the relief of pain during the movement of the thorax/ribs will allow for a bigger expansion of the rib cage.<sup>9</sup> However, the fractures in our patients was at the thoracic and lumbar levels. The decline in our VAS scores in the early-term was bigger when compared with other studies in the literature. Our results show that the patient satisfaction in this group is higher than those without respiratory problems.

Taginawa et al. compared the results of respiratory tests with the number (single- or multi-level) and localization (thoracic, thoracolumbar, lumbar) of the fractures in acute/subacute OVCF patients and observed a decrease in pain in all patients regardless of the level and number of fractures. However, the authors reported a significant increase in FVC values of patients with fractures in the thoracic region, regardless of the number of fractures and concluded that the fracture-related pain is the main reason to emergence of the restrictive syndrome and decline in thoracic movement. In addition, they also purported that the decrease in the local kyphosis angle (LKA) in multi-level OVCF patients is the leading cause in deterioration of pulmonary functions<sup>12</sup>.

There are several studies in the literature reporting a time-dependent decline in respiratory function test results of OVCF patients who were not performed a surgical treatment. However, it has also been shown that the MVV reaches its peak value after three months even in patients who received conservative treatment for three months<sup>12</sup>. The decrease in the respiratory capacity due to ineffective use of respiratory muscles will further lead to a decrease in the already low values of COPD patients under conservative treatment versus those of the normal population. It might take some time for the muscles to return to their previous capacities following surgery due to the probability of atrophy that might develop after ineffective use of the muscles during conservative treatment.

In studies assessing the efficacy of vertebroplasty on pulmonary functions, COPD patients were excluded<sup>3,6</sup>. This is due to an attempt in establishing standardization of the spirometric values. Unlike previous studies, our study was conducted only on COPD patients.

There are several limitations of our study. First, our study is not a randomized and prospective one. It would be possible to obtain more objective results if we could follow up our COPD patients with compression fractures with respiratory function tests in the period before and after the fracture, and in the postoperative term in addition to comparing their pain scores with the drug use data. The one-month period between the surgery and PFT is adequate to do comparison with the preoperative term. However, repeating the test in the long-term at frequent intervals will better exhibit the efficacy of the treatment.

The biggest difference of COPD patients than the normal population is the methods of use and side effects of their medication. The use of vital inhaler medication which requires deep inhalation is more challenging in these patients. For these reasons, applying a conservative treatment in these patients, especially after an OVCF, will aggravate the already existing pulmonary problems. In making a decision for surgical treatment, one should take the current status of the patient into account and not insist for conservative management.

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