Balloon Kyphoplasty for Chronic Compression Fracture: A Case Series

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Abstract

Vertebral compression fractures (VCFs) are relatively common phenomena, with increased incidence and prevalence with the expected aging population and increased life expectancy. Kyphoplasty is one option for vertebral augmentation intervention that may be used to treat VCFs. There are studies that report within acute to subacute timeline of 12 weeks or less promotes the greatest restoration in height and pain, however there is a sparse literature regarding patients that may still benefit from the procedure in the chronic phase. This case series reports on three patients who underwent kyphoplasty with chronic symptomatic compression fractures greater than 12 weeks, who experienced improved pain and functional status post-procedure.

Keywords: Vertebral compression fractures; Lower back pain; Kyphoplasty; Osteoporosis; Hypertension; Chronic.

Abbreviations: VCF: Vertebral Compression Fracture; CASH: Cruciform Anterior Spinal Hyperextension; RFA: Radiofrequency Ablation.

Introduction

Vertebral compression fractures (VCFs) are a relatively common phenomena, with an estimated 1.5 million compression fractures occurring annually in the United States alone, effecting between 30-50% of individuals over the age of 50 [1,2]. This number is expected to increase with the aging population and increased life expectancy [3]. Vertebral compression fractures are often defined by 15-20% or 4mm loss of vertebral body height on imaging, and may be caused by several etiologies including trauma, bone metastasis, infection, and most commonly osteoporosis [4].

While some estimates suggest up to 20-30% of VCFs are incidental, existing literature also supports that many patients with compression fractures experience significant lower back pain, impaired mobility, and activities of daily living (ADLs), decreased mood, decreased pulmonary function, as well
as increased morbidity and mortality [3,4,5]. A study by Olekisk, et al., demonstrated even a significant number of patients with subclinical incidental fractures reported adverse effects on quality of life [6]. Additionally, research suggests that patients who have sustained one VCF have up to a five-fold risk of sustaining future fractures, thus providing adequate treatment options, as well as prevention is important for this patient population [1].

Conservative therapies for VCFs include analgesics, bed rest, bracing, and rehabilitation. However, in patients with osteoporosis, weight-bearing exercise is crucial in the prevention of disease progression. The American Society of Pain and Neuroscience (ASPN) Clinical Guidelines of Interventional Treatments for Low Back Pain recommends that some vertebral compression fractures may be managed conservatively, however those associated with significant vertebral height loss, kyphotic deformity, debilitating pain-limiting function, progression of vertebral height loss, evolution of symptoms and advanced imaging findings may warrant vertebral augmentation [2,7].

Indications for non-urgent interventions include acute (<6 weeks) painful vertebral compression fractures confirmed by advanced diagnostic imaging within 30 days, sub-acute (<6 months) painful vertebral compression fractures confirmed by advanced diagnostic imaging, presence of debilitating severe pain and functional deficits related to a vertebral fracture, severe pain on a daily basis, defined as>6/10 on a visual analog scale or numeric pain, significant functional impairment and inability to perform ADLs, such as non-ambulatory or limited ambulation, limited transfers, bathing, self-care, or lack of satisfactory improvement with at least 4 weeks of non-surgical management as defined above[2].

Kyphoplasty is one option of vertebral augmentation intervention that may be used for treating VCFs. This procedure involves insertion of an inflatable balloon under image guidance to create a cavity in the vertebral body, followed by introduction of filling material, usually biocompatible cement, under low pressure [2,6,8]. The goals of kyphoplasty are to restore vertebral height, reduce kyphosis, and ultimately reduce pain and improve function in patients who have sustained VCF [4,6,7,9-11].

Several existing studies have evaluated the efficacy of balloon kyphoplasty for VCFs and found it does provide benefit to patients regarding the above procedure goals, with overall low complication rates. Reports suggest that between 60-92% of patients experienced rapid and significant pain relief following the procedure, and 47% of patients demonstrated restoration of vertebral body height loss [3,6,10-13]. While many of these studies suggest the highest amount of success when this procedure is performed early, after failed conservative measures, the exact definition of this timeline and consensus on treatment timing has not been firmly reached. Several studies suggest intervention within acute to subacute period of 12 weeks or less promotes the greatest restoration in height and pain relief, therefore this is a commonly practiced timeline [2,5,13].
However, a small amount of existing literature suggests patients may still benefit from the procedure in the chronic phase after 12 weeks [7,11,12,14,15]. One chronic fracture study, where all patients had VCFs>12 months, demonstrated statistically significant and possibly clinically important improvement in pain and gain in mobility at 3, 6, and 12 months [12]. An additional prospective study by Kasperk, et al., examined sixty patients with painful vertebral fractures presenting for>12 months, with 40 patients undergoing kyphoplasty compared to 20 control patients, and showed significant increased vertebral height, reduced pain and improved mobility in patients following kyphoplasty [13]. Given limited currently literature examining patient outcomes following kyphoplasty for chronic, >12-week, symptomatic compression fractures, this case series aims to add to existing literature by presenting outcomes of three patients with chronic VCFs who underwent kyphoplasty.

Case 1

The patient was an 84-year-old female with a past-medical history of osteoarthritis, degenerative disc disease at L5-S1, osteoporosis, hypertension, hypothyroid, and B12 deficiency who initially presented in August of 2023 with 6 months of worsening axial lower back pain, rated 6/10. At the initial presentation Patient denied associated numbness, weakness, tingling or bowel or bladder symptoms. Patient pain worsened with standing and walking and improved with rest. At the time of referral, the patient had undergone bilateral L4-5 and L5-S1 epidural steroid injections, a lumbar radiofrequency ablation, as well as a 6-week course of physical therapy without relief. The physical exam demonstrated midline tenderness to palpation at the thoracolumbar junction, and weakness in bilateral hip flexion secondary to lower back pain.

Given these exam findings and ongoing symptoms, lumbar spine X-ray imaging was ordered with 3 views. This imaging demonstrated a T12 compression fracture, likely in the setting of known osteoporosis. Follow-up MRI imaging was obtained which demonstrated also demonstrated a compression fracture of the T10 vertebral body with 50% reduction in body height as well as a T12 compression fracture with 40% reduction in vertebral body height, and L1 with 75% reduction in vertebral body height. No spinal cord compression was noted on the imaging. Given the imaging result the patient was provided with a CASH brace, as well as intranasal calcitonin, with continued physical therapy. Patients elected to undergo T12 and L1 kyphoplasty are given ongoing pain. Patients underwent T12 and L1 fluoroscopy guided balloon kyphoplasty with bone cement under low pressure in September of 2023. The procedure was completed with monitored anesthesia care with sedation, resulting in direct reduction of the fracture, with end plate movement and approximately 5 mm of height restoration. The patient tolerated the procedure well with minimal blood loss and no acute complications noted.

Following the procedure the patient had some post-operative pain improved with oral medications. At the 2-week follow-up appointment, the patient reported significant relief to the lower back but with some persistent pain. At follow-up one month later,
the patient reported ongoing thoracic pain. The exam demonstrated tenderness to palpation at the T10 level and was subsequently scheduled to undergo T10 kyphoplasty. Patient underwent the procedure as described above in January of 2024. At a one-month follow-up appointment

The patient reported an 80% reduction in their pain symptoms immediately following the procedure, with some slowly worsening pain since then, particularly with back extension. Patient also reported increased tolerance to forward flexion, which Patient was previously unable to complete.

Figure 1: Case 2, pre-procedure T1-weighted MRI imaging.

Case 2
The patient was an 80-year-old female with a past medical history of hypertension, type 2 diabetes mellitus, hyperparathyroidism, hyperlipidemia, osteoporosis, and remote history of ER+ breast cancer who initially presented February of 2023 to the emergency department with intractable lower back pain, after outside hospital MRI imaging one week prior to admission demonstrated an L2 compression fracture with 40% loss of vertebral body height. The patient had been in a motor vehicle collision in October of 2022, approximately 16 weeks before presentation, resulting in an abdominal hematoma and right ankle fracture, and had been experiencing lower back pain since shortly after this accident, despite initial imaging being negative for fracture. Prior to presentation, the patient had received epidural steroid injections, a dexamethasone taper, as well as physical therapy with minimal relief of her symptoms.

X-rays obtained at the time of admission also demonstrated an acute T12 compression fracture, and follow-up MRI imaging confirmed compression fracture with less than 40% loss of height at T12 without retropulsion. Given the severity of her symptoms, the patient elected to undergo T12 and L2 kyphoplasty procedures. The procedures were performed under monitored
anesthesia care with sedation, and patients tolerated them well without immediate complications. One-week post-procedure patient reports some ongoing pain at the procedure site. The patient was evaluated in clinic and recommended for CASH brace, and intranasal calcitonin. Post-operative pain medications including oxycodone and cyclobenzaprine were slowly weaned. Follow-up CT imaging demonstrated stable post-procedure changes. Following a 1-month post-procedure the patient reported overall improvement in pain and mobility. Approximately 2 months following her initial procedure, the patient presented once again with worsening lower back pain. MRI thoracic and lumbar spine demonstrated new compression fractures at T10, T11, L1 and L3. The patient then underwent L1 and L3 balloon kyphoplasty as described above in March of 2023. Follow-up imaging showed L4 and L5 compression fractures for which patient underwent balloon kyphoplasty in May of 2023. At one-month follow-up appointment patient reported significant improvement in pain rated 6/10 occurring primarily with walking or extension from previously 9/10 constantly before all procedures.

Case 3
The patient was a 76-year-old male with a past medical history of hyperlipidemia, type 2 diabetes, atrial fibrillation, prostate cancer, and amyloidosis who initially presented in October of 2023 with 3.5 months of progressively worsening lower back pain following a mechanical fall. Patient described the pain as non-radiating without associated numbness, weakness, bowel, or bladder difficulties. The pain was exacerbated with activity rated 7/10 at its most severe. Conservative measures with oral baclofen, physical therapy and radiofrequency ablation did not improve symptoms. Outside hospital MRI imaging obtained demonstrated an L3

Figure 2: Case 2, pre-procedure T2-weighted MRI imaging.
compression fracture with 30% vertebral height loss and old compression deformity of L1. Repeat X-ray at the initial visit demonstrated L3 and L1 compression fractures. The patient subsequently underwent L3 balloon kyphoplasty under monitored anesthesia with sedation in December of 2023. Patients tolerated the procedure well, with minimal post-operative pain. At one-week follow-up the patient reported pain was overall improved, as bending and walking were more tolerable, and reported pain as 2/10 with activities. At his 2-month follow-up patient continued to report overall improvement in pain, and improved physical function with ongoing physical therapy.

Figure 3: Case 2, procedural fluoroscopy following cement placement.

Figure 4: Case 3 pre-procedure T1-weighted MRI imaging.
Discussion

Existing literature often recommends patients with symptomatic compression fractures undergo vertebral augmentation including kyphoplasty within the first 10-12 weeks of injury to maximize outcomes [13,16]. However, this case series aimed to evaluate whether patients with chronic symptomatic compression fractures for greater than 12 weeks may still achieve pain relief and functional gains after kyphoplasty occurring after the recommended 10-12-week period. We present three cases in which patients with chronic injuries reported subjective symptomatic relief and functional improvement following kyphoplasty after

Figure 5: Case 3 pre-procedure T2-weighted MRI imaging.

Figure 6: Case 3 procedural fluoroscopy following cement placement.
failure conservative measures outside of the acute injury period.

Given the favorable outcomes seen in this case series with patients who underwent kyphoplasty for chronic vertebral compression fractures, this case series brings forth questions regarding the optimal timing of kyphoplasty after the occurrence or diagnosis of a vertebral compression and potential complications with delayed intervention with kyphoplasty. Previous research studies have evaluated the effect of early versus late kyphoplasty on outcomes and have suggested more favorable outcomes with earlier intervention. One retrospective study revealed that patients who underwent early balloon kyphoplasty (<4 weeks) had significantly lower back pain scores and lower rate of subsequent vertebral fractures when compared to those who underwent late kyphoplasty (>4 weeks) [17]. Another retrospective study comparing early intervention (within 2 weeks of fracture) versus delayed intervention (15-28 days after fracture) found a reduced risk of cement leakage in the delayed intervention group and better high restoration rate in the early intervention group [18]. This study also showed that there was no statistical significance in visual analogue (VAS) and Oswestry Disability Index (ODI) scores between the two groups.

Similarly, a retrospective study comparing intervention within 4 weeks versus after 4 weeks found that both groups did not have a statistical difference in their VAS and ODI scores, but there was a lower rate of subsequent fracture and better height restoration rate in the early intervention group [19]. Although there is evidence that quality of life, opioid use, and pain improve in both acute (<10 weeks) and chronic (>4 months) fracture patients after kyphoplasty, fracture reduction and vertebral height restoration is greater in acute fractures than chronic fractures. In addition to reduction in pain and disability, research has also suggested the positive impact of earlier kyphoplasty on opioid prescribing [20].

Current literature delineated several benefits to early intervention with kyphoplasty in the management of VCFs. Our case series shows that these benefits may continue to be seen in the chronic phase greater than 12 weeks after fracture. However, it is not clear at which exact time point after the vertebral compression fracture, do the benefits of kyphoplasty diminish significantly and when this procedure should no longer be considered as a result.

While Author presents a case series of the successful treatment of chronic compression fracture-related pain and functional impairment in three patients, there are several limitations to this study. As it is a case series, it represents a small sample size of patients undergoing this procedure, so larger scale randomized studies are needed to determine statistical significance for pain and functional improvement. Additionally, while overall well tolerated with minimal complications, Authors observe one patient who sustained adjacent compression fractures following the procedure, though reported significant improvement with subsequent intervention.

This is a previously described adverse event that may be associated with balloon
kyphoplasty, and it is unclear whether timing of procedure impacts this risk [7].

Overall, this case series demonstrates the successful treatment of chronic compression fractures in a small number of patients, supporting further investigation into kyphoplasty treatment time with larger scale studies. Given the outcomes reported in this study, patients with symptomatic compression fractures who have failed conservative measures but are no longer within the acute to subacute phase of injury, may still find significant pain relief and functional benefits by electing to undergo this minimally invasive procedure.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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