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Original Research Article

The role of concomitant vitamin D3 and K2 treatment after laminectomy in spinal stenosis surgery of patients with osteoporosis

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ABSTRACT

Background: Readmission because of ongoing pain and complaints who undergone spinal surgery with osteoporosis is increasing. This study investigated the efficacy of concomitant vitamin D3 and K2 usage in the surgical treatment of patients with lumbar spinal stenosis who have osteoporosis. The aim of the study was to treatment strategy is to reduce the patient's low back pain and decrease readmission rates due to ongoing pain.
Methods: A total of 22 patients with osteoporosis included in the study who had lumbar decompression via laminectomy surgery with posterior instrumentation for spinal stenosis. Patients were divided into groups according to use additional supplement of vitamin D3+K2. Group 1 was control group who received only vitamin D3 and group 2 was patients who received vitamin D3+K2 treatment. Patients were called to their sixth month check-up and their pre- and post-treatment VAS scores and Roland-Morris scores were filled in and readmission rates due to ongoing pain were compared.
Results: 9 male and 13 female participants with a mean age of 64.4 were in the study. The mean T-score in bone mineral density (BMD) was -2.7 in group 1 and -2.6 in group 2. A significant difference was found when the pre-operative and post-operative VAS and RM scores of all patients were compared ($p<0.05$). The mean readmission rates due to ongoing pain is 4 in group 1 and 7 in group 2. A significant difference was found when readmission rates due to ongoing pain were compared ($p<0.05$).
Conclusions: Concomitant vitamin D3 and K2 usage in the surgical treatment of patients with lumbar spinal stenosis who have osteoporosis is a valuable treatment option to reduce the rate of admission to the hospital because of ongoing pain.

Keywords: Vitamin D3, Laminectomy, Stenosis, Osteoporosis, Vitamin K2

INTRODUCTION

Low back pain in older patients is usually associated with age-related degenerative changes. The literature frequently states that disability associated with degenerative lumbar stenosis is a growing health problem among elderly.[1] Although spinal stenosis may occur with aging in almost every patient, clinically symptomatic spinal stenosis causes pain and numbness in lower back and lower extremity due to spinal compression.[2] With progressive compression, these neurological symptoms of lumbar spinal stenosis increase. After conservative treatment fails, lumbar decompression via laminectomy are widely used to reduce compression of spinal cord or nerve roots and restore stability.

Similar to high prevalence of lumbar spinal stenosis, osteoporosis (OP) is another common condition among elderly population. The increase in the aging population brought with it an increase in degenerative spinal surgeries, and concerns about spinal surgery in elderly patients with osteoporosis have increased.[3] Interest in this

topic has increased even after several studies have shown how osteoporosis can lead to adverse outcomes after spinal surgery.[4-6] Readmission because of ongoing pain and complaints who undergone spinal surgery with osteoporosis is increasing.[7]

The increasing incidence of osteoporosis has led to the necessity of trying many treatment modalities.[8] Evaluation of the physiological mechanism, vitamin K2 acts in the endoplasmic retinaculum as a cofactor for the enzyme gamma-glutamyl carboxylase, and stimulate calcium ion deposition and mineralization in the bone matrix.[9-11] Also, vitamin D3 (most active form 1,25 OH D3) plays a critical role in bone development.[12] Clinically, vitamin K2 and D3 are successful as anti-osteoporotic treatment. The literature has shown that the combination of vitamin K2 and vitamin D3 has additive or synergistic effects on bone; this therapy could be a promising low-cost treatment strategy for osteoporosis and related co-morbidities.[13,14]

This study investigated the efficacy of concomitant vitamin D3 and K2 in the surgical treatment of patients with lumbar spinal stenosis who have osteoporosis. The aim of the study was to study the treatment strategy to reduce the patient's low back pain and decrease readmission rates due to ongoing pain.

METHODS

The study began after receiving approval from the local ethics committee. Written informed consent was obtained from each patient. A single-center retrospective analysis of the data was performed.

36 patients with spinal surgery were followed by orthopedics and traumatology department. 22 patients included in the study who had treatment for vertebral fracture or spinal stenosis between 2020 and 2022 and whose complete records were available. Patients with osteoporosis who received appropriate bisphosphonate therapy in the endocrinology department follow-up were in the study.

A total of 14 patients whose records could not be reached and who did not come to their final controls were excluded from the study. Inclusion criteria were determined as patients with severe clinical and neurological symptoms due to lumbar degenerative diseases who failed conservative therapy and having lumbar decompression via laminectomy surgery with posterior instrumentation and having at least a 6 months follow-up.

Osteoporotic evaluation was done with bone mineral density (BMD) at the femoral neck and lumbar using DXA within one week before surgery. The T value was used to diagnose osteoporosis (T score≤-2.5). All of the patients were operated by two different spine surgeon team. All patients received the same post-operative pain relief treatment (opioid analgesia for the first three days post-operatively, and non-steroidal anti-inflammatory analgesia for 3-week follow-up). No additional treatment was given to the patients other than the drugs used in their comorbidities.

Patient data were accessed from the hospital automation system. The following parameters were retrospectively assessed: age, sex, surgery site and reason and receiving vitamin D3+K2 [25 µg vitamin D3 (1000 IU), 45 µg vitamin K2] (Orzax ocean, Istanbul). Patients were divided into groups according to use additional supplement of vitamin D3+K2. Group 1 was control group who received only vitamin D3 (1000 IU, daily dosage) and group 2 was patients who received vitamin D3+K2 [25 µg vitamin D3 (1000 IU), 45 µg vitamin K2, daily dosage) treatment. In both groups, treatment modalities were started one week before surgery and continued six months post-surgery. All patients were supported with low back exercises. Patients were called to their sixth month follow-up examination and their pre-and post-treatment Visual analogue scale (VAS) and Roland-Morris scores were filled in and readmission rates due to ongoing pain were compared.

Roland-Morris score was used to assess clinical and neurological symptoms which is composed of subjective symptoms, clinical signs and daily activity limitations parameters. The score is from 0 to 24 points (the higher the score, the more dysfunction). Meanwhile, the visual analog scale (VAS) was used to evaluate the patient's pain level. Scores ranging from 0 to 10 (the lower the score, the less pain).

Statistical analysis was in the Statistical Package for the Social Sciences (SPSS) 22 package program. Descriptive statistics results were in medians (minimum-maximum) and frequencies with percentages. The analyses were the Mann Whitney U-test and Chi square test. The results had a 95% confidence interval, and the statistical significance was at the $p<0.05$ level.

RESULTS

22 participants (9 male and 13 female) with a mean age of 64.4±10.2 were in the study. The mean age of the patients in Group 1 was 64±10 years and that in group 2 was 57±9.7. The mean follow-up of participants was 9±2 months. The mean T-score in BMD was -2.7±0.2. In group 1 and -2.6±0.1 in group 2. No statistically significant difference was present in the evaluation of the sex and follow-up of the patients and BMD of the patients ($p>0.05$). The clinical characteristics of the two groups are in Table 1.

The mean VAS scores of patients in group 1 was 8±0.77 before surgery and 2.27±1 after surgery. The mean VAS scores of patients in group 2 was 7.64±0.64 before surgery and 0.82±0.75 after surgery. A significant difference was found in the pre-treatment and post-treatment VAS scores of all patients ($p<0.05$). The mean Roland-Morris (RM) scores of patients in group 1 before surgery was 19.45±2.06 and it was 7.64±1.96 after surgery. The mean

Roland-Morris (RM) scores of patients in group 2 before surgery was 18.82±1.32 and it was 4.09±2.02 after surgery. A significant difference was found when the pre-operative and post-operative RM scores of all patients were compared ($p<0.05$) The mean readmission rates due to ongoing pain is 4 in group 1 and 7 in group 2. A significant difference was found when readmission rates due to ongoing pain were compared ($p<0.05$) (Table 2).

When the total laminectomy levels were evaluated, in group 1, the number of one segment laminectomy was 6, and the number of two segment laminectomy was 5. In group 2, the number of one segment laminectomy was 7, and the number of two segment laminectomy was 4.

No additional implant-related or wound complications were observed in any of the patients in groups 1 and 2 at the sixth month follow-up examination in this study.

Table 1: Comparison of clinical characteristics between group 1 and group 2.

Variables	Group		P value
	1	2	
Age (y)	64 (57-84)	57 (50-78)	0.03
Sex (M/F)	4/7	5/6	0.5
Follow-up (month)	6 (6-12)	9 (6-12)	0.7
BMD (T score)	-2.7	-2.6	0.27

Table 2: Comparison of clinical characteristics between group 1 and group 2.

Variables	Group		P value
	1	2	
VAS pre-operative	8 (7-9)	8 (7-9)	0.22
VAS 6th month	2 (1-4)	1 (0-2)	0.003
RM pre-operative	20 (17-21)	19 (17-21)	0,22
RM 6th month	8 (4-10)	4 (1-8)	0.001

DISCUSSION

In the current study, we present a pioneering study demonstrating that concomitant vitamin D3 and K2 usage after surgical treatment of patients with lumbar spinal stenosis who have osteoporosis is a valuable treatment option to reduce the rate of admission to the hospital because of ongoing pain and increase in daily life activities. The number of re-admissions to the hospital due to ongoing pain in patients who did not use vitamin D3+K2 increased almost two times. This is the first study as far as we have investigated in English literature that evaluate the clinical outcomes after laminectomy with this treatment modality. However, many previous studies have considered the role of vitamin K2 and vitamin D3 usage on bone healing and osteoporosis.

Bone density is the most critical component of a patient's bone health status. Fragility fracture is the initial event in osteoporosis and is the most morbid effect of low bone mass on the spine.[15] These fractures are mostly benign and often associated with significant pain. Although the effect of vitamin K2 on bone density is rather subtle, it has the potential to improve the mechanical properties of the bone and thus bone quality.[16] The function of vitamin K2 is that it is a cofactor of γ-carboxylase, and this aspect is particularly important as it is essential in the function of osteocalcin.[17] Gamma-carboxylated OC refers to active OC, which can effectively bind calcium to bone hydroxyapatite crystals.[18] Moreover, vitamin K2 has been shown to directly inhibit the Rank-Rank L pathway, thereby reducing osteoclastogenesis.[19] There are many studies report about the additive or synergistic effect of vitamin K2 and vitamin D3 in bone. When the literature is reviewed, it was suggested that vitamin K2 increased the mineralization induced by vitamin D3, the combination of vitamin D and vitamin K stimulated the differentiation of osteoblasts at the fracture site *in vitro*, and vitamin K2 increased the role of vitamin D3 on osteoblast precursor mesenchymal stem cells.[13,14,20]

Many aspects of bone and muscle health have been shown to affect the results of spinal surgery.[7] In the elderly, OP and sarcopenia often coexist, the number and size of muscle fibers are reduced.[21,22] Age-related partial or complete inactivity also increases the risk of muscle atrophy and bone loss, therefore bone loss increases the risk of fractures. Recent literature has also shown that vitamin K2 affects skeletal muscle cells through proliferation and cell migration *in vitro*, reducing cell differentiation and improving skeletal muscle function.[23] Enhancement in muscle function supported by low back exercises may improve clinical outcomes.

Considering all these reasons, we thought that the effect of vitamin D3+K2 treatment on bone and muscle healing cannot be ignored. The increasing incidence of sarcopenia related pain patients has been frequently mentioned in the literature recently.[24] Similarly, it was concluded that if patients with LSS have concurrent sarcopenia, there is a decrease in physical function, and reported more severe low back pain.[25] The idea that our patients increased their muscle strength was created by filling in the Roland Morris scoring, that they could use their muscles more comfortably and stronger, especially considering the muscle functions that are used more frequently in daily activities. At the same time, it was predicted that this treatment would contribute to bone healing faster with the reduction of pain in the surgical area of the patients. In the next step, it is planned to evaluate the patients for sarcopenia with CT scan as literature suggested and correlate it with bone mineral densitometry.

Limitations

Our study has limitations, such as being a retrospective study based on a small sample size. Studies with more

patients with homogenous groups are needed. Another limitation of the study, the fact that the follow-up period of the patients was not long enough to elucidate long-term results. Additional limitation is that we did not look at the BMD results at the last follow-up, but changes in BMD usually require at least one year of follow-up. With a longer follow-up period, clearer results can be obtained. In addition, it's not easy verify the results of the study, as the tests are very subjective. Finally, the lack of a complete optimization due to the lack of literature on how long this combination therapy should be continued may make the results of the study questionable.

CONCLUSION

Considering the early post-operative results, we concluded that the additive or synergistic effect of vitamin K2 and vitamin D3 may make this combination therapy a valuable treatment option to reduce the rate of admission to the hospital because of ongoing pain and increase in daily life activities.

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