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The evaluation of tear production and dry eye symptoms in patients with osteoporosis

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ABSTARCT

Aims: Osteoporosis is a systemic skeletal disorder characterized by decreased bone mass, compromised bone density and strength. Dry eye is a common disease of the ocular surface characterized by tear film instability with ocular discomfort, pain, and visual disturbances. Both conditions share risk factors, including age, gender, and hormonal factors. In this study, our aim is to assess the tear production and dry eye symptoms in patients with osteoporosis and compare their results a control group without osteoporosis.

Methods: In this cross-sectional study, we evaluated 32 osteoporosis patients and 30 age-matched controls without osteoporosis. Tear production was assessed using Schirmer test and the symptoms of dry eye using Ocular Surface Disease Index (OSDI) questionnaire. The results of both groups were compared.

Results: The mean age of the osteoporosis group was 61.4±4.9 years, and the mean age of the control group was 57.7±6.4 years (p:0.224). The Schirmer test results were 12.3±7.4 mm for the osteoporosis group and 23.1±13.7 mm for the control group. The Schirmer test results were significantly lower in the osteoporosis group (p:0.009). The mean OSDI scores for the osteoporosis group was 30.4±23.1 while it was 20.6±14.6 for the control group. The difference was not statistically significant (p:0.329).

Conclusion: This study reveals a potential connection between osteoporosis and dry eye. Patients with osteoporosis have lower tear production compared to control group without osteoporosis. Further research is necessary to understand this relationship and its implications.

Keywords: Osteoporosis, dry eye, Schirmer test, ocular surface disease index

INTRODUCTION

Osteoporosis is a systemic skeletal disorder characterized by decreased bone mass, compromised bone density and strength.[1,2] A bone mineral density (BMD) equal or lower than 2.5 standard deviations from the values observed in healthy, young adults is accepted as osteoporosis.[3] It impacts a substantial portion of the population, affecting individuals of varying genders, ethnic backgrounds, and is expected to rise in prevalence with the aging population.[4] It is more prevalent among women than men.[4] The clinical importance of osteoporosis primarily lies in the fragility fractures which occur as a consequence of this condition. There is a significant elevation in the risk of fractures in areas such as the proximal femur, distal radius, and vertebra.[3,5] These can cause significant morbidity, mortality and cost which makes this condition an important public health problem.

Dry eye is a common disease of the ocular surface characterized by tear film instability and often accompanied by symptoms such as ocular discomfort, pain, and visual disturbances.[1] The prevalence of dry eye disease (DED) is higher among women compared to men, and it tends to increase with advancing age.[6,7] It is accepted as a multifactorial disease with various factors contributing to its pathophysiology including ocular inflammation, environmental factors, systemic comorbidities, topical and systemic medications and lifestyle.[8,9]

These two diseases exhibit similar risk factors and epidemiological patterns. Both conditions are more prevalent in females and in patients with older age.[1] Both diseases share common underlying mechanisms including hormonal imbalances and inflammation. Osteoporosis is reported as a risk factor for dry eye development.[8] It is also frequently associated with Sjögren Syndrome, an important cause of severe dry eye with impaired tear production.[10] These data

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suggest the existence of a connection between the two diseases. Despite the possibility of a connection, there is a limited number of studies exploring the relationship between osteoporosis and dry eye. Most of these studies are population-based studies using medical records or studies using questionnaires without using tear function tests. Visual disturbances are correlated with an increased susceptibility to falls.[11] If there is a connection, by treating dry eye, it can be possible to prevent dry eye-related vision problems in osteoporotic patients which may reduce the likelihood of falls.

In this study, our aim is to assess the tear production and dry eye symptoms in patients with osteoporosis and compare their results a control group without osteoporosis.

METHODS

The study was carried out with the permission of Niğde Ömer Halisdemir University Non-interventional Clinical Research Ethics Committee (Date: 14.08.2023, Decision No: 2023/68).All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This study was conducted in Niğde Ömer Halisdemir University Bor Physical Therapy and Rehabilitation Training and Research Hospital. Information regarding the procedures was provided to both the patients and the control group, and their informed consent was obtained through both written and verbal means.

The cross-sectional study involved 32 individuals diagnosed with osteoporosis and included a control group comprising 30 participants. The assessment of osteoporosis patients took place at the outpatient clinics of the department of physical medicine and rehabilitation. Osteoporosis patients aged 45 years and older were included in the study, and the diagnosis of osteoporosis was established through bone mineral density (BMD) measurements conducted using dual-energy X-ray absorptiometry (DXA). A BMD T-score of -2.5 or lower measured from hip or spine is accepted as osteoporosis. The control group encompassed 30 patients without osteoporosis who visited the outpatient clinics for musculoskeletal pain. Comprehensive systemic and ocular histories were collected, which included information about systemic illnesses, previous ocular surgeries, and ocular diseases. Individuals with pre-existing conditions such as Sjögren's syndrome, rheumatoid arthritis, corneal pathologies, or a history of corneal surgery were excluded from both study groups. Both patients and controls underwent the Schirmer test (ST) without anesthesia, along with the completion of the Ocular Surface Disease Index (OSDI) questionnaire. During the Schirmer test, a standard ST filter strip (Bio Schirmer®, Bio-Tech Vision Care, Ahmedabad, Gujarat, India) was gently placed into the lateral inferior fornix, positioned at the intersection of the middle and lateral thirds of the lower eyelid. Patients were instructed to maintain their eyes open and blink naturally. Following a five-minute interval, the filter strip was carefully removed, and the wetting of the measurement strip was documented. The results of both eyes of the patients were included in the study. The OSDI questionnaire is a is a 12-item questionnaire commonly employed in dry eye studies, providing an assessment of symptom frequency, identification of environmental triggers, and an evaluation of vision-related quality of life.[12,13] The Turkish adaptation of the OSDI questionnaire has demonstrated its validity and reliability as an effective tool for assessing ocular symptoms in dry eye. It is recommended as a practical tool in the diagnosis of dry eye for routine clinical practice and for clinical research.[14]

Statistical Analysis Statistical analysis was conducted using SPSS version 20.0 (IBM Corporation, Armonk, NY). Quantitative data were presented in the format of means±standard deviations, while qualitative data were expressed as percentages (%). The independent-samples t-test was employed to compare groups regarding age, ST values and OSDI scores. In these analyses, statistical significance was defined as p-values less than 0.05.

RESULTS

A total of 32 participants were enrolled in this study group consisting of 32 females (100%). A control group including 30 female participants constituted the control group. The mean age of the study group was 61.4±4.9 years, and the mean age of the control group was 57.7±6.4 years. There was no significant difference between the groups in terms of age (p:0.224). The Schirmer test results were 12.3±7.4 mm for the osteoporosis group and 23.1±13.7 mm for the control group. The Schirmer test results were significantly lower in the osteoporosis group (p:0.009). The mean OSDI scores for the osteoporosis group was 30.4±23.1 while it was 20.6±14.6 for the control group. The difference was not statistically significant (p:0.329).

DISCUSSION

In this cross-sectional study we found that osteoporosis patients have lower Schirmer test results compared to control group without osteoporosis. This result indicates that patients with osteoporosis have lower tear production and supports the previous studies indicating osteoporosis as a risk factor for dry eye. Although the OSDI scores are lower in the osteoporosis group the difference between the groups was not significant. While the mean value of Schirmer test remained above the commonly utilized cutoff value of 10 mm, it's noteworthy that these patients do not manifest ocular symptoms, and

their measurements are lower than those observed in the control group. Collectively, within our study group, osteoporosis patients exhibit reduced tear production and demonstrate lower symptom severity, potentially suggesting the presence of a mild form of dry eye.

Several studies have hinted at the potential connection between osteoporosis and dry eye.[8] However, most of these studies have relied on medical records or questionnaires, without utilization of tear function tests to investigate this relationship. In the existing literature, we did not come across studies that specifically investigated dry eye in osteoporosis patients using dry eye tests and subsequently compared them with a control group without osteoporosis. In a retrospective cohort study in Taiwan utilizing data from the Health Insurance Database, Jeng et al.[1] suggested that osteoporosis represents a risk factor for the subsequent onset of dry eye syndrome. While the findings of this study are consistent with our findings, a direct comparison cannot be made due to the absence of dry eye test results in that study. Another study has also identified osteoporosis as a common comorbidity in patients with Sjögren's syndrome, a condition known to be a significant cause of severe dry eye.[10] Collectively, these findings suggest a relationship between dry eye and osteoporosis.

The effect of sex hormones was suggested as a factor in the development of both osteoporosis and dry eye. Symptoms of the dry eye are frequent among postmenopausal women, and there are sex hormone receptors on the ocular surface.[15] These findings have supported the hypothesis that sex hormones could have influence on tear production.[16,17] Although we did not investigate the levels of sex hormones in the current study, we expected similar sex hormone profiles in both groups since there were only age matched female patients in the study and control groups in this study. Our results suggest factors other than sex hormones are affecting tear production in patients with osteoporosis.

Vitamin D may be another important factor in the pathogenesis of both diseases. Calcium and vitamin D are crucial for the preservation of bone health, and there appears to be a positive correlation between vitamin D deficiency and the occurrence of osteoporosis.[18] It is reported that deficiency in vitamin D could be a risk factor for the development of dry eye syndrome and deficiency in vitamin D could impair tear production.[19] Tear production measured by Schirmer test was also found to be decreased in patients with low serum 25(OH) D levels which is the active metabolite of Vitamin D.[20] Our results showing lower tear production in patients with osteoporosis support these findings. Vitamin D may play a significant role in the coexistence of these two diseases.

In individuals with osteoporosis, falls can result in subsequent disabilities and mortality, and visual impairment plays a significant role in these incidents.[1,11] Our study underscores the elevated risk of developing dry eye syndrome among osteoporosis patients. It's crucial to note that dry eye can lead to visual disturbances, potentially increasing the likelihood of falls. Raising awareness of this relationship is important to decrease the risk of falls among individuals with osteoporosis.

Limitations

There are some limitations of the current study. The study did not investigate the levels of sex hormones or vitamin D, which are potential factors in the development of both osteoporosis and dry eye. Including such measurements could provide deeper insights into the mechanisms involved. The study primarily focused on female patients, and the results may not be directly applicable to males with osteoporosis. We used the Schirmer test and the OSDI questionnaire to assess dry eye syndrome. While these tests provide valuable insights, we recognize that a more comprehensive evaluation of tear function could enhance our understanding of the relationship between osteoporosis and dry eye.

CONCLUSION

Our study reveals a potential connection between osteoporosis and dry eye, with female patients with osteoporosis showing lower tear production compared to a control group. Although symptom severity was not significantly different, this suggests a mild or asymptomatic form of dry eye in osteoporosis patients. The shared risk factors, including age and gender, hint at common underlying mechanisms. Vitamin D deficiency may also play an important role. Further investigation is necessary to provide a more comprehensive understanding of the relationship between these two conditions.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Niğde Ömer Halisdemir University Non-interventional Clinical Research Ethics Committee (Date: 14.08.2023, Decision No: 2023/68).

Informed Consent: Written consent was obtained from the patient participating in this study.

Referee Evaluation Process: Externally peer reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Jeng YT, Lin SY, Hu HY, Lee OK, Kuo LL. Osteoporosis and dry eye syndrome: a previously unappreciated association that may alert active prevention of fall. *PLoS One.* 2018;13(11):e0207008.
2. Rachner TD, Khosla S, Hofbauer LC. Osteoporosis: now and the future. *Lancet (London, England).* 2011;377(9773):1276-87.
3. Sheik Ali A. Osteoporosis: a narrative review. *Cureus.* 2023;15(8):e43031.
4. Sözen T, Özışık L, Başaran N. An overview and management of osteoporosis. *Eur J Rheumatol.* 2017;4(1):46-56.
5. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. *Injury*. 2006;37(8):691-697.
6. Stapleton F, Alves M, Bunya VY, et al. TFOS DEWS II epidemiology report. *The Ocul Surface.* 2017;15(3):334-365.
7. Borrelli M, Frings A, Geerling G, Finis D. Gender-specific differences in signs and symptoms of dry eye disease. *Curr Eye Res.* 2021;46(3):294-301.
8. Qian L, Wei W. Identified risk factors for dry eye syndrome: a systematic review and meta-analysis. *PLoS One.* 2022;17(8): e0271267.
9. Gorimanipalli B, Khamar P, Sethu S, Shetty R. Hormones and dry eye disease. *Indian J Ophthalmol.* 2023;71(4):1276-1284.
10. Albrecht K, Dörner T, Redeker I, et al. Comorbidity and health care utilisation in persons with Sjögren's syndrome: a claims data analysis. *Clin Exp Rheumatol.* 2020;38 Suppl 126(4):78-84.
11. Yip JL, Khawaja AP, Broadway D, et al. Visual acuity, self-reported vision and falls in the EPIC-norfolk eye study. *Br J Ophthalmol.* 2014;98(3):377-82.
12. Wolffsohn JS, Arita R, Chalmers R, et al. TFOS DEWS II diagnostic methodology report. *Ocul Surface.* 2017;15(3):539-574.
13. Barabino S, Labetoulle M, Rolando M, Messmer EM. Understanding symptoms and quality of life in patients with dry eye syndrome. *Ocular Surface.* 2016;14(3):365-376.
14. Irkec MT, Group TOS. Reliability and validity of turkish translation of the ocular surface disease index (OSDI) in dry eye syndrome. *Invest Ophthalmol Vis Sci.* 2007;48(13):408-408.
15. Hat K, Planinić A, Ježek D, Kaštelan S. Expression of androgen and estrogen receptors in the human lacrimal gland. Int J Molecul Sci. 2023;24(6):5609
16. Feng Y, Feng G, Peng S, Li H. The effect of hormone replacement therapy on dry eye syndrome evaluated with schirmer test and break-up time. J Ophthalmol. 2015;2015:420302.
17. Peck T, Olsakovsky L, Aggarwal S. Dry eye syndrome in menopause and perimenopausal age group. *J Midlife Health.* 2017;8(2):51-54.
18. Voulgaridou G, Papadopoulou SK, Detopoulou P, et al. Vitamin D and calcium in osteoporosis, and the role of bone turnover markers: a narrative review of recent data from RCTs. *Diseases (Basel, Switzerland).* 2023;11(1):29
19. Liu J, Dong Y, Wang Y. Vitamin D deficiency is associated with dry eye syndrome: a systematic review and meta-analysis. *Acta Ophthalmol.* 2020;98(8):749-754.
20. Jin KW, Ro JW, Shin YJ, Hyon JY, Wee WR, Park SG. Correlation of vitamin D levels with tear film stability and secretion in patients with dry eye syndrome. *Acta Ophthalmol.* 2017;95(3):e230-e235.