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ORIGINAL ARTICLE

Relationship Between Calcium and Vitamin D Level and Bone Stress Fracture in Young Athletes

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ABSTRACT

Objective: To determine the association of vitamin D and serum calcium with stress fractures in young athletes.

Methods: In this prospective case-control study, we included 160 young athletes who presented to the department of orthopedics, CMH Abbottabad from June-2022 to January-2023. Among those there were 80 patients who presented with stress fractures and 80 patients were those who presented with lower extremity fractures other than stress fractures. Serum calcium and vit. D levels were determined in all patients.

Results: Mean age in patients with stress fractures (cases) was 20.3±6.1 years while those in control group was 21.7±8.4 years (p-value 0.22). Mean vit. D levels were significantly lower in cases group; 24.64±11.2 ng/mL versus 30.2±14.7 ng/mL in control group (p-value 0.007). Mean serum PTH levels were no statistically significantly different between the groups; 3.2±1.3 pmol/L versus 3.4±1.7 pmol/L in cases and control group respectively, p-value 0.40. Serum calcium levels in cases were lower; 1.9±0.8 mmol/L in comparison to control group; 2.1±0.7 mmol/L, with p-value 0.01.

Conclusion: There is a significant association of serum calcium and vitamin D levels with stress fractures. So regular intake of vitamin D containing foods and milk products should be advised to young athletes to reduce the risk of stress fractures.

Keywords: Stress fractures, Athletes, calcium, Vitamin D.

INTRODUCTION

Many medical professionals, therapists, and sportsmen are familiar with the term "stress fracture." Overuse injuries are a common cause of stress fractures, which can be either partial or total. Stress fractures are induced by repetitive submaximal bone loading.[1] Although the site of the stress fracture might change from sport to sport, it is typically found in the lower extremities.[2, 3] They are especially prevalent in those who engage in strenuous physical activity, such as, but not limited to, those who compete in track and field, individuals who run long distances, dancers, and military individuals.[4] It has been reported that between 6.5 to 9.7% of athletes who participate in a variety of sporting activities suffer from stress fractures.[5] According to the findings of a number of studies a change in the routine that an athlete follows for their training is one of the most important contributors to the risk of injury.[6]

Extrinsic factors, such as training regimen and type of sport, and intrinsic factors, such as gender and race or ethnicity, as well as biomechanical, anatomical, and hormonal factors, all have a role in determining the risk of stress fractures.[7] Nutritional intakes, notably calcium, which is required for bone mineralization, and vitamin D, which is required for maintaining calcium homeostasis and bone remodelling, have been indicated as protective against stress fractures. Both of these nutrients are essential for maintaining calcium homeostasis and bone remodelling.[7] Although it is commonly recommended that people with poor bone health increase their calcium intake by increasing their consumption of dairy products and calcium-rich foods, the research supporting this suggestion has been called into question.[8] In addition, although vitamin D deficiency is very prevalent among adolescents, there is a dearth of data about the role that vitamin D intake, whether sufficient or in excess of the required intake9, plays in the maintenance of bone health.[9, 10]

Vitamin D is a lipophilic hormone that is created naturally within the body and is very necessary for appropriate skeletal health maintenance. Humans contain a number of inactive precursors as well as an active version. Cholecalciferol, often known as vitamin D3 precursor, is created by the skin when exposed to sunlight. The liver then converts vitamin D3 into 25-hydroxyvitamin D, also known as 25(OH)D.[11]

In present study, we determined the association of vitamin D and serum calcium with stress fractures in young athletes.

METHODS

In this prospective case-control study, we included 160 young athletes who presented to the department of orthopedics, CMH Abbottabad from June-2022 to January-2023. Among those there were 80 patients who presented with stress fractures and 80 patients were those who presented with lower extremity fractures other than stress fractures. Study approval was obtained from hospital IRB. All patients signed consent for study participation.

In all patients, venous blood samples were obtained and sent for determination of serum calcium, serum parathyroid hormone (PTH) and vitamin D levels. Comparison of these variables between the groups was made using independent sample t-test.

RESULTS

Mean age in patients with stress fractures (cases) was 20.3±6.1 years while those in control group was 21.7±8.4 years (p-value 0.22). We included controls of similar age to prevent biasness. There were only 4 (5.0%) female patients in cases and 9 (11.25%) in controls (p-value 0.15). Mean BMI was 23.4±2.4 Kg/m^2 in cases and 23.9±2.1 Kg/m^2 (p-value 0.16). There were 6 (7.5%) current smokers in cases and 10 (12.5%) smokers in controls (p-value 0.16) [Table 1].

Mean vit. D levels were significantly lower in cases group; 24.64±11.2 ng/mL versus 30.2±14.7 ng/mL in control group (p-value 0.007). Mean serum PTH levels were no statistically significantly different between the groups; 3.2±1.3 pmol/L versus 3.4±1.7 pmol/L in cases and control group respectively, p-value 0.40. Serum calcium levels in cases were lower; 1.9±0.8 mmol/L in comparison to control group; 2.1±0.7 mmol/L, with p-value 0.01 (Table 2).

Table 1: Baseline Characteristics.

	Cases (N=80)	Control (N=80)	p-value
Age	20.3±6.1	21.7±8.4	0.22
Female Gender	4 (5%)	9 (11.25%)	0.15
BMI (Kg/m^2)	23.4±2.4	23.9±2.1	0.16
Current Smokers	6 (7.5%)	10 (12.5%)	0.29

Table 2: Association of Vit. D and Calcium with Stress Fractures.

	Cases (N=80)	Control (N=80)	p-value
Vit. D Levels (ng/mL)	24.64±11.2	30.2±14.7	0.007
Serum PTH (pmol/L)	3.2±1.3	3.4±1.7	0.40
Serum Calcium Levels (mmol/L)	1.9±0.8	2.1±0.7	0.01

DISCUSSION

Pain that is localised and gradually gets worse is generally described by an athlete who has a stress fracture. Stress fractures most frequently occur in the lower extremities. In addition, athletes who are having a stress fracture have stated that the pain is made worse by movement and made better by rest.[4, 12] Athletes who have stress fractures typically tell a history of initiation of a new activity, increase in physical activity, or routine changes.[12] Stress fractures can also be caused by a change in routine that is not related to physical activity. They complain of a dull, aching pain that is felt deep in any lower extremity area. This pain can be felt anywhere in the body. Even though the pain is not incapacitating during athletic activity, it is generally connected with a stress fracture if it is localised in a specific region and appears in the evening. This could be the foot, ankle, or hip. A stress fracture may be the cause of pain that returns or persists despite taking time off to rest and/or employing ice, rest and compression.[13]

The diagnosis of a stress fracture can be made based on the patient's medical history as well as certain diagnostic imaging. It is essential to get an early diagnosis of a bone stress injury in order to prevent it from developing into a stress fracture.[14] An appropriate history and physical examination ought to be carried out on a runner in the event that there is a suspicion that they have a stress fracture. The history of the athlete, in conjunction with a proper physical examination, serves as the foundation for determining whether or not the athlete has a stress fracture.[15] At the beginning of the symptoms, radiographs may not be positive, and it may take several weeks for radiologic signals, if they are there, to become visible.[16, 17] If the pain does not go away, it may be necessary to undergo more advanced imaging.[1]

In this study we determined the association of vit. D and calcium with stress fractures in young athletes, we found significant association of serum calcium and vit. D with stress fractures, as vit. D, and serum calcium levels in stress group were significantly lower in comparison to control group of patients.

Similar results were reported by Khan et al. who reported high prevalence of hypocalcemia and vit. D insufficiency in stress fractures military personals in comparison to control group.[18]

It is necessary to identify modifiable causes and risk factors (such as nutrition) in order to stop stress fractures from happening.[19] It is usual practise to classify the elements that put a person at risk for exercise and sports-related injuries, such as stress fractures, as either intrinsic or extrinsic. Intrinsic variables are characteristics of the person training or participating in a sport, such as their demographics, skeleton, level of physical fitness, and risky behaviour. Environmental influences have little impact on intrinsic factors. Extrinsic risk factors are elements in the environment or outside of the particular player that affect the likelihood of suffering harm. The kind of sport played or the equipment used are two examples of extrinsic risk variables.[19]

Additionally, it is advised to get enough calcium and 25(OH)D [170,171], as well as the proper amount of weight-bearing exercise and strength training throughout one's life, in order to optimise bone health.[20]

CONCLUSION

There is a significant association of serum calcium and vitamin D levels with stress fractures. So regular intake of vitamin D containing foods and milk products should be advised to young athletes to reduce the risk of stress fractures.

REFERENCES

1. McInnis KC, Ramey LN. High-Risk Stress Fractures: Diagnosis and Management. PM & R : the journal of injury, function, and rehabilitation. 2016;8(3 Suppl):S113-24.
2. Matcuk GR, Jr., Mahanty SR, Skalski MR, Patel DB, White EA, Gottsegen CJ. Stress fractures: pathophysiology, clinical presentation, imaging features, and treatment options. Emergency radiology. 2016;23(4):365-75.
3. Shapiro M, Zubkov K, Landau R. Diagnosis of Stress fractures in military trainees: a large-scale cohort. BMJ military health. 2022;168(5):382-5.
4. Knapik JJ, Reynolds KL, Hoedebecke KL. Stress Fractures: Etiology, Epidemiology, Diagnosis, Treatment, and Prevention. J Spec Oper Med. 2017;17(2):120-30.
5. Wentz L, Liu PY, Haymes E, Ilich JZ. Females have a greater incidence of stress fractures than males in both military and athletic populations: a systemic review. Mil Med. 2011;176(4):420-30.
6. Saunier J, Chapurlat R. Stress fracture in athletes. Joint Bone Spine. 2018;85(3):307-10.
7. Lennox GM, Wood PM, Schram B, Canetti EFD, Simas V, Pope R, et al. Non-Modifiable Risk Factors for Stress Fractures in Military Personnel Undergoing Training: A Systematic Review. Int J Environ Res Public Health. 2021;19(1).
8. Ratajczak AE, Zawada A, Rychter AM, Dobrowolska A, Krela-Kaźmierczak I. Milk and Dairy Products: Good or Bad for Human Bone? Practical Dietary Recommendations for the Prevention and Management of Osteoporosis. Nutrients. 2021;13(4).
9. Moreira CA, Bilezikian JP. Stress Fractures: Concepts and Therapeutics. J Clin Endocrinol Metab. 2017;102(2):525-34.
10. Richards T, Wright C. British Army recruits with low serum vitamin D take longer to recover from stress fractures. BMJ military health. 2020;166(4):240-2.
11. Bikle DD. Vitamin D: Production, Metabolism and Mechanisms of Action. In: Feingold KR, Anawalt B, Blackman MR, Boyce A, Chrousos G, Corpas E, et al., editors. Endotext. South Dartmouth (MA): MDText.com, Inc.

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12. Patel DS, Roth M, Kapil N. Stress fractures: diagnosis, treatment, and prevention. Am Fam Physician. 2011;83(1):39-46.
13. McCormick F, Nwachukwu BU, Provencher MT. Stress fractures in runners. Clin Sports Med. 2012;31(2):291-306.
14. Gallo RA, Plakke M, Silvis ML. Common leg injuries of long-distance runners: anatomical and biomechanical approach. Sports health. 2012;4(6):485-95.
15. Song SH, Koo JH. Bone Stress Injuries in Runners: a Review for Raising Interest in Stress Fractures in Korea. J Korean Med Sci. 2020;35(8):e38.
16. Jacobs JM, Cameron KL, Bojescul JA. Lower extremity stress fractures in the military. Clin Sports Med. 2014;33(4):591-613.
17. DeFroda SF, Cameron KL, Posner M, Kriz PK, Owens BD. Bone Stress Injuries in the Military: Diagnosis, Management, and Prevention. Am J Orthop (Belle Mead NJ). 2017;46(4):176-83.
18. Khan AS, Sadiq A, Alam Khan MQ, Syed HM, Mukarrum SJPAFMJ. Risk factors for the development of stress fractures: a case control study. Pak Armed Forces Med J. 2020;70(6):1651-56.
19. Warden SJ, Edwards WB, Willy RW. Preventing Bone Stress Injuries in Runners with Optimal Workload. Current osteoporosis reports. 2021;19(3):298-307.
20. Warden SJ, Davis IS, Fredericson M. Management and prevention of bone stress injuries in long-distance runners. J Orthop Sports Phys Ther. 2014;44(10):749-65.