Original Article

Trochlear apparatus calcification and its association with diabetes: A cross-sectional study among patients undergoing computed tomography scan involving orbit

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Abstract

Introduction: Trochlear apparatus calcifications can be found incidentally on computed tomography (CT) scans involving the orbit. The calcification often is misdiagnosed as intraorbital foreign body and vice versa. This study aims to find the prevalence of trochlear apparatus calcification and its association with diabetes.

Methods: A cross-sectional study was conducted at a medical college hospital from January 2021 to March 2021. Two hundred and fifty-three patients undergoing CT of the brain and paranasal sinuses were recruited. The trochlear apparatus calcification is considered when attenuation is high at the point of angulation of the superior oblique muscle. Frequency and percentages were used, and Fischer's exact test was done for association. coGuide software was used for data analysis.

Results: The participant's mean age was 49.16 ± 18.42 years. Out of 253 participants, 137 (54.15%) had diabetes. The prevalence of trochlear apparatus calcification was 3.95%. Out of 137 people with diabetes, 5 (3.65%) had trochlear apparatus calcification.

Conclusion: The study shows that trochlear apparatus calcification prevalence was 3.95%. This benign calcification in CT should be differentiated from ocular foreign body and other pathological conditions.

Keywords: Diabetes mellitus, eye foreign bodies, orbit, tomography

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INTRODUCTION

Computed tomography (CT) scan has become a commonly used diagnostic imaging modality. A small focus of high attenuation in the orbital CT has various causes. Most commonly occurs intraorbital foreign body, trochlear calcification, and other pathological calcification.[1] The prognosis for these causes can vary; hence, differentiating between these causes is essential.

A cartilaginous structure through which the tendon of the superior oblique muscle passes is the trochlear apparatus.[1,2] It is located at the superior and inferior parts of the orbit as a U-shaped structure.[3,4] This trochlear apparatus is not seen in CT routinely. However, due to calcification of the trochlear apparatus, a dense particle could be visible in CT. It can occur unilaterally as well as bilaterally. Trochlear apparatus calcification does not produce any

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signs or symptoms. Hence, they are mostly ignored by the radiologist and the ophthalmologist. Trochlear calcification often mimics the intraocular foreign body. More so in cases of eye injury or trauma. Hence, it becomes essential to diagnose and differentiate trochlear calcification. This can change the course of further treatment.

Intraorbital pathologic calcification can be due to various causes such as retinoblastoma, osteoma, hemangioma, lymphangioma, or varicosities.[5] Incidental asymptomatic orbital calcifications of the eyeball upon orbital CT are drusen of the optic nerve head, sclera, and dura surrounding the proximal optic nerves.[3] A previous study by Ko *et al*. has shown that incidental intraorbital calcification is more commonly observed in CT scans.[1] There is a need to differentiate this benign incidental finding from other pathological calcifications and foreign bodies. Hart *et al*.[2] evaluated the association between diabetes, age, and trochlear calcification. The researchers concluded that a young patient's calcification seen in trochlear CT could predict underlying diabetes. Study in the past has shown an association between trochlear apparatus calcification and diabetes mellitus (DM).[2] This study was conducted to evaluate the prevalence of trochlear apparatus calcification and its association with DM.

METHODS

A cross-sectional study was conducted in the department of radiodiagnosis at Sri Devaraj Urs Medical College. The study duration was from January 2021 to March 2021. After obtaining ethical clearance from the institutional ethics committee, the patients undergoing CT of the brain and paranasal sinuses were recruited. Patients below 18 years of age, orbital fractures, and patients with known intraorbital tumors were excluded from the study. Informed written consent was obtained, and data confidentiality was maintained. CT scan was performed using 16-slice multidetector CT (SIEMENS® SOMATOM Emotion 16). Trochlear calcification was diagnosed when attenuation was high at the point of angulation of the superior oblique muscle. The data were entered in a pro forma containing information regarding the patient's age, sex, any underlying ocular disease, the diabetes status, and CT finding of trochlear calcification.

Ethics statement

The study was approved by the institutional human ethics committee and institutional review board (Reference: DMC/KLR/IEC/675/2020-21). Data confidentiality was maintained. Written informed consent was obtained from the patients.

Statistical analysis

Trochlear apparatus calcification was considered as the primary outcome variable. Diabetes was considered as a primary explanatory variable. Descriptive analysis was carried out by the mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. Data were also represented using appropriate diagrams like bar diagrams. Categorical outcomes were compared between study groups using the Chi-square test. Fisher's Exact test (If the overall sample size was <20 or if the expected number in any one of the cells is <5, Fisher's exact test was used.) $P < 0.05$ was considered statistically significant. Data were analyzed by using coGuide software, V.1.0 coGuide Statistics software, Version 1.0, BDSS corporation. Bangaluru, India.[6]

RESULTS

A total of 253 subjects were included in the final analysis.

The mean age was 49.16 years in the study population. Among the study population, 171 (67.59%) were male and remaining 82 (32.41%) were female. Out of 253 participants, 137 (54.15%) had diabetes. The prevalence of trochlear apparatus calcification was 3.95% [Table 1 and Figure 1].

Out of 137 people with diabetes, 5 (3.65%) had trochlear apparatus calcification. The difference in the proportion of trochlear apparatus calcification between diabetes was statistically not significant ($P = 1.000$) [Table 2]. The CT image with bilateral trochlear apparatus calcification is shown in Figure 2.

In people with diabetes, 2.92% had trochlear apparatus calcification on the right side and 2.19% had left side calcification [Table 3].

DISCUSSION

This cross-sectional study was conducted to evaluate the prevalence of trochlear apparatus calcification and find its association with diabetes. The study's findings showed

Table 1: Summary of baseline parameter (*n*=253)

Summary	*n* (%)
Age (years)	49.16±18.42 (ranged 18-97)
Gender	
Male	171 (67.59)
Female	82 (32.41)
Underlying ocular disease (nil)	253 (100)
Diabetes	
Yes	137 (54.15)
No	116 (45.85)

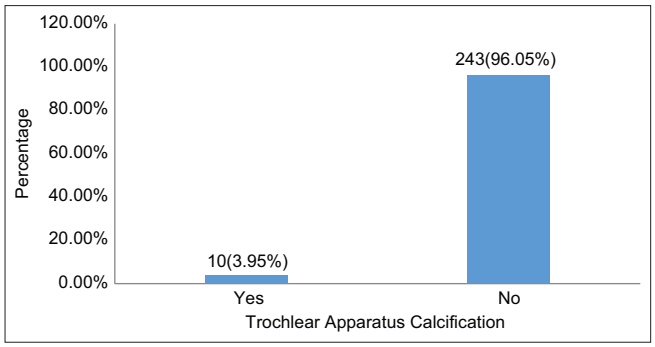

Figure 1: Bar chart of trochlear apparatus calcification in the study population (*n* = 253)

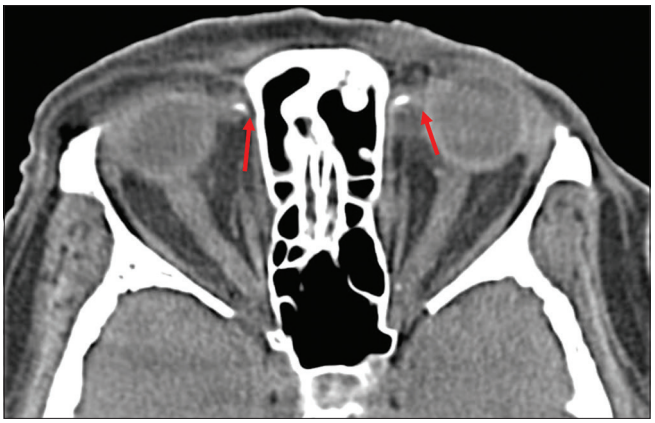

Figure 2: Computed tomography scan axial section at the level of bilateral orbits shows bilateral trochlear apparatus calcification

Table 2: Comparison of diabetes between trochlear apparatus calcification (*n*=253)

Diabetes	Trochlear apparatus calcification		Fisher's exact (*P*)
	Yes, *n* (%)	No, *n* (%)	
Yes (*n*=137)	5 (3.65)	132 (96.35)	1.000
No (*n*=116)	5 (4.31)	111 (95.69)	

Table 3: Comparison of diabetes between trochlear apparatus calcification (*n*=253)

Parameter	Diabetes	
	Yes, *n* (%)	No, *n* (%)
Trochlear apparatus calcification right	4 (2.92)	1 (0.86)
Trochlear apparatus calcification left	3 (2.19)	4 (3.45)

that out of 253 participants, 137 (54.15%) had diabetes. The prevalence of trochlear apparatus calcification was 3.95%. Out of 137 people with diabetes, 5 (3.65%) had trochlear apparatus calcification. There was no statistically significant association between diabetes and trochlear apparatus calcification.

The mean age group of the study participants was 49.16 ± 18.42 years. The majority of 67.59% were males. Similar age groups and male predominance were observed in a retrospective study done by Ko *et al*.[1] Hart *et al*.[2] observed an increase in prevalence in advancing age.

The prevalence of trochlear apparatus calcification was 3.95% in the current study. This was in contrast to the high prevalence (16%) observed in the study by Ko *et al*.[1] The trochlear apparatus in the eye is a cartilaginous structure within a synovium-lined sheath that allows uncontrolled movement of the superior oblique muscle.[7] The superior oblique muscle tendon passes through it as it makes a sharp lateral bend to insert on the superior lateral part of the orbital globe. The reasons for calcification are unclear, but inflammatory, degenerative, and metabolic processes can be the probable causes—timely discrimination between intraorbital calcifications and intraorbital foreign bodies for patients undergoing magnetic resonance imaging. Blindness can occur due to the movement of an intraocular foreign body during the imaging, and the foreign body identified by an earlier CT scan was thought to be calcification.[8] Attenuation values on CT are of inadequate use because of volume averaging. Although the presence and place of trochlear calcification are pretty distinctive, the possibility of a metallic foreign body should not be excluded by these criteria alone.

Few pathologic conditions can involve the trochlea. Brown's syndrome, also known as tendon sheath syndrome, is a disease of ocular motility with restriction of active and passive elevation of the globe in adduction.[9] Various causes include superior oblique tendon and its sheath anomalies, inflammatory diseases, orbital trauma, and postoperative changes. Patients may report a clicking sensation in the area of the trochlear apparatus, and at times acute inflammation is presented by pain and tenderness in the trochlear region. Acquired Brown's syndrome can be an unusual complication of rheumatoid arthritis.[10] Low-signal intensity and a nodular appearance of the tendon have been documented on magnetic resonance images of a patient with long-standing juvenile rheumatoid arthritis and Brown's syndrome.[11] Inflammation of the tendon and the tendon sheath lead to thickening of the superior oblique muscle and tendon, which has been observed on sonography and CT.[12,13]

In this current study, out of 137 people with diabetes, 5 (3.65%) had trochlear apparatus calcification. The difference in the proportion of trochlear apparatus calcification between diabetes was statistically insignificant (P = 1.000). Other studies have suggested that trochlear calcification in the age group below 40 years can be considered an early marker of underlying diabetes.[2]

A study by Murray *et al*.[3] reviewed 100 CT scans, of which 2% had bilateral drusen of the optic nerve, a calcified scleral

plaque was seen in 3% of the CT scans, and trochlear calcification was seen in 3% of the CT scans.

Hart *et al*.[2] reported an association between calcification of the trochlear apparatus and DM. They reviewed the orbital CT scans of 159 patients and observed trochlear calcifications in 19 (12%) of 159 patients. They also found a significant correlation (odds ratio, 4.3; 95% confidence interval, 1.4 to 12.9) between diabetic patients under 40 years of age and the presence of calcification in the trochlear apparatus. They suggested that trochlear calcification in these patients is strongly associated with DM.

CONCLUSION

The study shows that trochlear apparatus calcification prevalence was 3.95%. This benign calcification in CT should be differentiated from the ocular foreign body and other pathological conditions. The clinical significance is that the CT findings should be correlated clinically, and appropriate diagnoses should be made. The prognosis of the patient depends on this differentiation.

Limitations

The limitation of the current study is the relatively small sample and single-center study. Hence, the generalizability to the general population is a query. The current study could not establish the exact location of calcification either in tendon cartilage or sheath. Studies on a large sample and varied population groups are recommended in future. Studies exploring the etiology of calcification are also recommended.

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Conflicts of interest

There are no conflicts of interest.

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