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Original Article

Incidence of Calcification of the Trochlear Apparatus in the Orbit

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Purpose: To quantify the incidence of asymptomatic incidental trochlear calcifications and to describe their clinical features.

Methods: We retrospectively reviewed orbital computed tomography (CT) scans of 216 patients to identify the presence of trochlear calcifications. We analyzed the prevalence, age distribution, and gender preponderance of trochlear calcifications. We also examined age-specific prevalence rates for trochlear calcifications, as well as their relationship to systemic disease.

Results: The mean age of patients was 26.8 years. Trochlear calcifications were observed in 35 (16%) of the 216 patients, and 18 of the 35 patients had bilateral calcifications. The rate of trochlear calcification was higher in males; 32 (20.9%) of 153 male patients had trochlear calcifications, compared with 3 (4.8%) of 63 female patients. Age, hypertension, diabetes mellitus, and thyroid disease were not significantly associated with the incidence of trochlear calcifications.

Conclusions: Incidental asymptomatic orbital calcification is more commonly observed on CT images than we expected and occurs predominantly in male patients. Understanding this to be a relatively common, benign finding may help us to rule out foreign bodies and other pathologic conditions.

Key Words: Calcification, Diabetes mellitus, Orbital diseases, Trochlear apparatus, X-ray computed tomography

Foci of high attenuation in the orbit upon unenhanced orbital computed tomography (CT) has various causes, including pathologic calcifications, trochlear calcifications, and, foreign bodies. Differentiating between these causes is important, as the prognosis can vary by cause.

Pathologic calcification within the orbit upon unenhanced CT scans can be caused by retinoblastoma, osteoma, hemangioma, lymphangioma, or varicosities [1]. 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 [2]. A recent study suggested that calcification in the trochlear apparatus was strongly associated with diabetes mellitus (DM) in patients less than 40 years of age [3]. We evaluated the incidence and clinical features of trochlear calcification, as well as the associations between trochlear calcifications, age, and systemic disease.

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Materials and Methods

We reviewed orbital CT scans between January 2006 and January 2007, independent of patient diagnoses. Patient charts were reviewed, and the following parameters were recorded; age, sex, underlying ocular disease, and systemic disease. Studies were preformed on a Mx8000 IDT16 CT scanner ver. 2.0 (Philips, Amsterdam, Netherland) with 2-mm axial and coronal views of the orbits. Trochlear calcification was diagnosed when attenuation was high at the point of angulation of the superior oblique muscle (Fig. 1). Calcifications in this location were close to but not contiguous with the medial orbital wall.

We also analyzed the prevalence, age distribution, and gender preponderance of trochlear calcifications. We also examined age-specific prevalence rates for trochlear calcifications and related them to systemic disease.

Statistical comparisons between groups were conducted using chi-square tests and, $p<0.05$ were considered statisti-

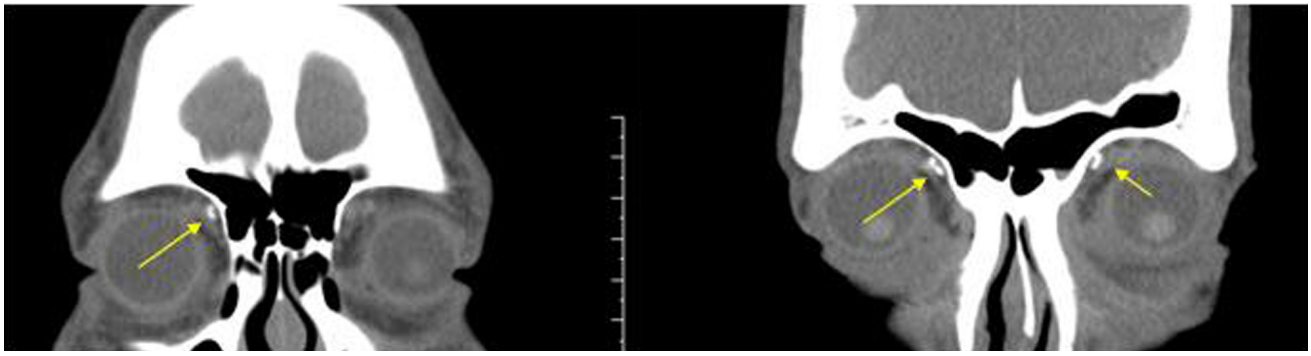

Fig. 1. Coronal computed tomography scans show calcifications in the trochlear apparatus of the superior oblique muscle (arrows).

cally significant. Furthermore, we studied the associations with systemic diseases in our patients. The odds ratio for detecting trochlear calcifications was calculated for diabetic compared to non-diabetic patients and hypertensive compared to non-hypertensive patients. Statistical analyses were performed using SPSS ver. 12 (SPSS Inc, Chicago, IL, USA).

Results

Two hundred sixteen orbital CT scans in 216 patients were included. Patient ages ranged from 1 month to 79 years (mean age, 28 years), and all of the patients were Korean. Of the 216 patients, 63 (29.2%) were female, and 153 (70.8%) were male. One hundred-fifty six patients had acute orbital trauma, and 60 patients had a known or suspected tumor, thyroid disease, infection involving the orbit, or vascular malformations. The high percentage of males in this study could be explained by the fact that the majority of trauma patients were young men.

In 35 (16%) of 216 patients, trochlear calcifications were observed on CT scans. All of these patients had orbital trauma. Calcifications were bilateral in 22 (62.9%) patients, and unilateral in 13 (37.1%). Trochlear calcifications could be observed on 2 serial planes of the orbital CT scans in all of the patients. This result meant that the calcification sizes were approximately 2 mm to 4 mm because a 2-mm slice thickness was chosen in the coronal plane.

Table 1. Age distribution and prevalence of patients with trochlear calcifications

Age (yr)	No. of Patients	
	Trochlear calcification (%)	Total
0-9	0 (0)	47
10-19	5 (9)	53
20-29	7 (23)	30
30-39	7 (33)	21
40-49	9 (35)	26
50-59	4 (18)	22
60-69	3 (30)	10
70-79	0 (0)	7
Total	35 (16)	216

All 35 patients in whom calcifications were observed had no symptoms or functional abnormalities related to trochlear calcification. Four of the 35 patients with calcifications had eye-movement disorders due to orbital blow-out fractures. Trochlear calcification was not identified in any of the patients examined with orbital tumors, thyroid disease, infection involving the orbit, or vascular malformations.

The age distribution of the patients and the prevalence rates in each age group are listed in Table 1. When we separately examined the patients under 40 years of age and compared them to those 40 years of age or older, the association between age and trochlear calcification was statistically significant (Pearson's chi-square test, p=0.028). When the patients over 50 years of age were compared with those under 50 years of age, however, no statistically significant difference was observed (Pearson's chi-square test, p=0.744). Therefore, the aging process does not appear to be correlated with the appearance of the trochlear calcifications.

Thirty-two (20.9%) of 153 male patients had trochlear calcifications, as compared with 3 (4.8%) of 63 female patients. There was a significant difference in the occurrence of trochlear calcifications between male and female patients (Pearson's chi-square test, p=0.003).

Of the 216 patients, 12 patients had DM, 11 patients had hypertension, and 5 patients had both DM and hypertension. There were 2 patients with DM and 3 patients with hypertension among the 35 patients with trochlear calcifications. One of these patients both had DM and hypertension. Two (17%) of the 12 diabetic patients had trochlear calcifications, as compared with 33 (16%) of 204 non-diabetic patients (OR, 1.036; 95% CI, 0.217 to 4.948). Three (27%) of the 11 hypertensive patients had trochlear calcifications, as compared with 32 (15%) of the 205 normotensive patients (OR, 2.027; 95% CI, 0.510 to 8.054). We were not able to find significant relationships, however, between trochlear calcifications and DM or hypertension.

Discussion

The trochlear apparatus of the eye is a cartilaginous

structure with a synovium-lined sheath that permits unimpeded movement of the superior oblique muscle [4]. One limitation of our study was that we could not clarify the accurate locations of calcifications, although cartilage, the synovial sheath, and the tendon itself are all possible locations [3-7].

Murray et al. [2] reviewed one hundred orbital CT scans. Of those scans, 2% had bilateral drusen of the optic nerve head, 3% had calcified scleral plaques anterior to the medial or lateral rectus muscles, and 3% had bilateral ossification of the trochlear apparatus.

Hart et al. [3] 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 (OR, 4.3; 95% CI, 1.4 to12.9) between diabetic patients under 40 years of age and the presence of calcification in the trochlear apparatus. They suggested that the presence of trochlear calcification in these patients is strongly associated with DM.

In contrast to the findings of Hart et al. [3], we did not find a significant correlation between patients under 40 years of age with DM and the presence of trochlear apparatus ca- lcifications. This could be related to our patient population, who were predominantly healthy young males with histories of trauma. Therefore, to better characterize this relationship, it would be necessary to recruit more patients with DM and compare their incidence of trochlear calcification to that of a control group.

We did not observe an increase in trochlear calcifications with advancing age or the presence of systemic disease. Therefore, our results indicate that trochlear calcifications are not suggestive of a degenerative process and occur regardless of chronic medical disease.

In this study, the prevalence rate of trochlear calcification was 16% (35 of 216 patients), which is higher than that of previous reports. We also found that trochlear calcifications were more prevalent in male patients. A racial and gender predilection is possible, and further investigation is necessary to evaluate this possibility.

In our study, all patients who had trochlear calcifications had acute orbital trauma. Among these patients, certain traumatic mechanisms could have affected calcification of the trochlear apparatus. Generally, however, it takes a long time for calcification to occur after trauma, so we assume that the calcifications we detected were incidental.

None of the 35 patients in our study had symptoms related to their trochlear calcification. Four of the 35 patients with trochlear calcifications had eye-movement disorders. These four patients had unilateral orbital blow-out fractures, and their symptoms immediately occurred after trauma on the side ipsilateral to the fractured orbit. All of these patients had bilateral trochlear calcifications. Therefore, we conclude that the eye-movement disorders of these patients were not related to their trochlear calcifications.

In summary, incidental asymptomatic trochlear calcifications are more commonly observed on CT scans than we expected and are predominant in male patients. We did not find a relationship between trochlear calcifications and systemic disease. If these findings in the trochlear apparatus are perceived to be benign, it may help us distinguish these densities from foreign bodies or pathological calcifications.

In the future, further randomized case-control studies are needed to determine the incidence of trochlear calcifications as they relate to race and other systemic disease.

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