




# Ocular Manifestations of Buerger's Disease – A Review of Current Knowledge

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**Abstract:** Buerger's disease, also known as thromboangiitis obliterans, is a disorder of primarily small and medium arteries and veins of the arms and legs. We have failed to find a comprehensive review discussing a possible link between the disease and the eyes. The aim of this study is to review current knowledge on the topic of ocular manifestations in the course of Buerger's disease. The Medline and Web of Science databases were searched without a time or language limit. We have managed to review 13 articles, describing the involvement of the eyes in thromboangiitis obliterans. It appears that patients suffering from Buerger's disease may develop non-arteritic anterior ischemic optic neuropathy (NAION), occlusive retinal vasculitis and periphlebitis, papillophlebitis, central retinal artery occlusion (CRAO), branch retinal artery occlusion (BRAO), normal tension glaucoma (NTG), uveitis, chorioretinal atrophy, retinitis, papillitis, optic atrophy, changes typical for hypertensive retinopathy. Additionally the abnormalities in electroretinography might be present. The treatment options and the possible outcome depend on the type of ocular manifestations, so it seems impossible to propose a universal therapy. We would like to raise awareness of the possible ocular manifestations in the course of Buerger's disease.

**Keywords:** Buerger's disease, anterior ischemic optic neuropathy, central retinal artery occlusion, normal tension glaucoma, uveitis

## Introduction

The involvement of the eye in the course of systemic diseases has been the topic of extensive research. In some disorders ocular manifestations have been found to be one of the first signs and symptoms. In others, however, they develop as complications secondary to the initial health problem. The connection between the eye and diseases such as diabetes mellitus, hypertension, sarcoidosis or multiple sclerosis has been studied for many years. In recent years some interesting links between rare diseases and ocular findings have been observed. Kreuzpointner et al described ophthalmological complications of Lemierre syndrome.<sup>1</sup> The ocular involvement and the role of optical coherence tomography in Fabry disease was studied by Wiest et al.<sup>2</sup> Multimodal imaging was shown by Böni et al to be effective in disclosing choroidal lesions in patients with disseminated Mycobacterium chimaera infection.<sup>3</sup> Carneval et al demonstrated how useful optical coherence tomography angiography was in revealing ocular vascular changes in patients with systemic sclerosis.<sup>4</sup> Even though extensive research has been conducted in the field of systemic diseases and their impact on the eye, we have failed to find a review discussing a possible link between Buerger's disease and some ocular findings.

Buerger's disease, also known as thromboangiitis obliterans, is a disease of primarily small and medium arteries and veins of the arms and legs.<sup>5</sup> It was first reported by an Austrian physician Felix von Winiwarter in 1879, however, it was named after an Austrian American physician Leo Buerger, whose description of the pathological basis was very accurate (1908).<sup>6,7</sup> The highest prevalence of the disease is in the Middle and Far East. It constitutes 45% to 63% of all patients with peripheral arterial disease in India as opposed to Western Europe, where it accounts for 0.5 to 5.6%.<sup>5</sup> The annual incidence in the United States is equal to 12.6 per 100,000.<sup>8</sup> The disease usually affects tobacco smoking men under 45

years of age. The ratio of men to women suffering from thromboangiitis obliterans equals 10:1 respectively.<sup>9</sup> Smoking tobacco has been proven to be one of the main risk factors. However, it was discovered that the disease might also affect smokeless tobacco users (eg tobacco chewers).<sup>9</sup> Another risk factor is chronic gum disease, although the reasons for it are still unknown.<sup>10</sup> When left untreated, Buerger's disease may lead to the development of gangrene because of insufficient blood supply. The most important form of prevention is quitting smoking.<sup>10</sup>

The symptoms of Buerger's disease are caused by stenosis and occlusion of small blood vessels, which leads to ischemia typically of the upper and lower extremities.<sup>8</sup> The patients suffer from intermittent claudication of the upper and lower extremities, rest pain, ulcers and gangrene, Raynaud's phenomenon, change of skin colour, tingling and numbness of fingers and toes. Although the typical signs and symptoms connected with the extremities are well known, other manifestations of the disease seem understated. Fakour and Fazeli conducted a systematic review, in which they presented 78 case reports, 2 case series and 3 original papers concerning the involvement of the following organs in patients with thromboangiitis obliterans: the gastrointestinal tract, the heart, the central nervous system, the eye, the kidneys, the urogenital system, the mucocutaneous zones, the joints, the lymphohematopoietic system and the ear.<sup>11</sup> In some patients the involvement of other organs had been noted long before the diagnosis of thromboangiitis obliterans whereas in others the first signs and symptoms later linked to Buerger's disease began after the diagnosis. The results of Fakour and Fazeli's study seem to be consistent with the findings of Leo Burger, who observed visceral arterial involvement in the patients with thromboangiitis obliterans he had examined.<sup>11</sup> According to Fakour and Fazeli, neglecting a possible systemic character of the disease might be unfavourable for the patients. Olin et al also stated that some larger blood vessels (eg cerebral, coronary, pulmonary, mesenteric, renal) might be affected by the disease.<sup>12</sup> Cabezas-Moya and Dragstedt described intestinal involvement of thromboangiitis obliterans in a patient, and Harten et al observed cerebral, splenic, pulmonary and myocardial signs of the disease.<sup>13,14</sup>

What also seems noteworthy is the involvement of the eye in other types of vasculitis. The prevalence of ocular symptoms is significant in granulomatosis with polyangiitis (50%), Behçet's disease (60%-80) and giant cell arteritis (12%-70%).<sup>15-17</sup> One third of patients with systemic lupus erythematosus develop ocular signs and symptoms, too.<sup>18</sup> This made us raise the question whether thromboangiitis obliterans is localized vasculopathy or a systemic disorder like the diseases mentioned above.

The aim of this study was to review current knowledge on the topic of ocular manifestations in Buerger's disease and raise awareness on the possible systemic character of the disease.

## Materials and Methods

The search strategy consisted in searching the Medline and Web of Science databases without a time or language limit by entering the following key words or phrases: "Buerger's disease", "thromboangiitis obliterans" in conjunction with "ocular", "ocular manifestations", "eye" and "ophthalmology". The last search was conducted on the 28th of May 2021. The inclusion criterion regarding Buerger's disease we adopted was the diagnosis of the condition provided by the authors of the reviewed articles. The inclusion criterion for the ophthalmological involvement was any type of ocular manifestation with no restrictions. Buerger's disease is known as a very rare disorder. Ophthalmological complications in its course are even rarer. We were keen on reviewing any type of article. The exclusion criterion was when there was no reference to the eye involvement in the course of Buerger's disease. The references of the reviewed articles were also screened so as not to omit any eligible papers. The search was conducted independently by two authors (USzP and JPD). The total number of records identified from both databases equaled 142. After removing duplicates with the use of Zotero we considered 42 articles. After reading abstracts or full texts 29 articles were excluded from the study as not relevant to the topic. The final number of articles, on which our study is based equals 13. We reviewed 10 cases of ophthalmological manifestations of Buerger's disease (each case was a separate publication) and 3 studies describing the involvement of the eye in Buerger's disease in 43 patients (Homma et al. – 9 patients, Arslan et al. – 24 patients, Valdes et al. – 10 patients).<sup>19-21</sup>

The form of the presentation was mainly inspired by Fakour and Fazeli's article entitled "Visceral bed involvement in thromboangiitis obliterans: a systemic review".<sup>11</sup> However, we decided to resign from some features included in the original work and replace them with what we believed to be more relevant to the topic. In the systematic review the

tables included more categories connected to internal medicine, whereas we wanted our article to be mostly about the ophthalmological aspects. We decided not to write about the duration of Buerger's disease and the smoking status. Instead, we wanted to describe in detail all the performed imaging tests and ophthalmological findings. We also included some information on the course of Buerger's disease in each case.

## Results

We present 9 articles in the form of a table summing up the findings (Table 1). The other 4 publications will be discussed in a narrative form. We would have liked to include all the information coming from our research in one table. Yet, not from all the analyzed works could we obtain enough information to fill in the appropriate categories in the table. For example, for Coppeto and Adamczyk or Homma et al only abstracts were available.<sup>19,22</sup> Arslan et al's work or Valdes et al's paper, on the other hand, are not case reports.<sup>20,21</sup> The structure of these studies is different, which means that they are incomparable to the case reports presented in the table. To avoid numerous empty slots in the table, we decided to discuss all the incomplete data separately.

As mentioned above, we have found 4 articles which we would like to discuss in a narrative form. Coppeto and Adamczyk reported anterior ischemic optic neuropathy in a 77-year-old patient suffering from Buerger's disease.<sup>22</sup> Arslan et al examined 26 men suffering from Buerger's disease and compared them to 26 healthy men in a similar range of age.<sup>20</sup> The only risk factors in both groups were male gender and smoking. The patients suffering from thromboangiitis obliterans were diagnosed based on the criteria proposed by Shinoaya.<sup>23</sup> The extra-ophthalmological signs and symptoms of some patients included: segmental occlusions in extremities, foot wounds (12), rest pain and hyperemia (14), wounds on the fingers (3), positive Allen's test (6). Nineteen patients had undergone unilateral lumbar sympathectomy, 2 patients had bilateral lumbar sympathectomy performed and in 4 cases finger amputation was carried out. All patients were treated with acetylsalicylic acid (150 mg). In the experimental group only 2 patients had no pathology in the fundus of their eyes. The other patients presented with optic atrophy (2 patients) and atherosclerotic hypertensive retinopathy (10 patients - grade I, 12 patients - grade II). In the control group only 4 patients were diagnosed with grade I retinopathy and the results of the other patients were unremarkable.<sup>20</sup> Homma et al observed severe narrowing of the bulbar conjunctival arteries in patients with thromboangiitis obliterans.<sup>19</sup> Valdes et al performed electroretinography in 10 patients previously diagnosed with Buerger's disease on the basis of clinical, angiographical and anatomopathological criteria.<sup>21</sup> They observed changes in the latency, amplitude and number of oscillatory potentials as well as changes in the a and b waves in the electroretinogram (eg elongated latency of OP, absence of subcomplex b, decreased amplitude of OP, decreased number of OP).<sup>21</sup>

The number of patients with ocular manifestations of Buerger's disease described in the reviewed articles equaled 44. We did not take into account the study published by Homma et al, as the exact number of patients with ocular involvement had not been given. The percentage of different types of ophthalmological involvement is given in Table 2.

## Discussion

The first reports concerning ocular manifestations of Buerger's disease date back to the 1930s and 1940s. The following presentations were described: narrowing and obliteration of a vascular lumen in the vessels of the retina, iris and ciliary body in retinal periphlebitis, iritis, iridocyclitis, complicated cataract, phthisis bulbi, choroiditis, vitreous opacities, choroid atrophy, white colouring of the retinal artery, white sheath on the retinal arteries, embolism of the central retinal arteries, hemorrhages in the retina and the vitreous body, retinitis proliferans, retinal atrophy, optic atrophy and Eale's disease.<sup>33</sup> Except for the case report published in the 1980s, the topic was not further researched until the next millennium. We managed to review 13 articles describing the involvement of the eyes in the course of thromboangiitis obliterans. We presented 10 isolated cases and 3 studies (conducted by Homma et al, Arslan et al, Valdes et al and Homma et al) showing ophthalmological changes in more than one patient. There seems to be no more studies on a larger group.

The criteria for the diagnosis of Buerger's disease differ depending on the author. Ollin et al have included the following aspects in the diagnosis: "an age of less than 45 years and current (or recent) history of tobacco use; the presence of distal-extremity ischemia (indicated by claudication, pain at rest, ischemic ulcers, or gangrene) documented

**Table I** Review of 9 Articles Concerning Ocular Manifestations of Buerger's Disease

Authors, Year of Publication	Sex and Age of the Patient on Admission, the Affected eye	Extra-Ophthalmologic Signs and Symptoms and Past History	Symptoms, Signs and Basic Examination on Admission	Results of the Ophthalmic Examination of the Affected eye	Final Diagnosis	Treatment	Outcome
Boeke W. and Duncker G, 1983 <sup>24</sup>	Male, 30, right and left eye	Thrombophlebitis of the deep leg and pelvic veins (recurrences of the thrombophlebitis in the lower extremities were accompanied by deterioration in the eye condition)	-	Slit lamp of OU: features of anterior uveitis, opacification of the vitreous body, complicated cataract Fundoscopy of OU: white retinal foci, retinal hemorrhages, retinal edema, constriction of the retinal vessels	Bilateral uveitis, retinitis and papillitis (recurrent)	Azathioprine (150 mg/d) Fluocortolone (15 mg every other day) Phenprocumarol	Visual loss Optic atrophy VA OD = 1/15 VA OS = 0.1 Concentric constrictions in the visual field
Dimopoulos I.S. et al., 2020 <sup>25</sup>	Male, 48, right eye	Recurrent ulcers at the tip of the fingers (duration: 3 years) Macrocytosis (probably secondary to the alcohol intake) Protein C and antithrombin III deficiency Abnormal photoplethysmography in the upper limb arterial duplex scan - small vessel occlusive disease in the upper extremity and a mild degree of reverse flow in the left ulnar artery Digital pitting, finger nail bed changes	Sudden onset of vision loss VA OD = 20/500 VA OS = 20/20	Fundoscopy of OD: ischemic retina, cotton wool spots Fundoscopy of OS: normal	Occlusive retinal vasculitis and periphlebitis	Aspirin 81 mg/day po	-
	One year later - left eye	-	Sudden onset of severe vision loss VA OD = 20/600 VA OS = cf at 1m	Slit lamp of OU: mild nuclear sclerotic cataract Fundoscopy of OU: retinal thinning in the macular region, vascular loops with collateralization, dot-blot and flame-shaped hemorrhages, arteriolar narrowing with venular dilation and sheathing Additionally in the fundus of OD: a few nerve fiber layer infarcts FA: early phase vessel wall staining involving veins and collateral arteries and mid/ late phase leakage, the arm-retinal and arteriovenous transit times for the left eye was equal to 16.8 s and 11.3 s respectively, the foveal avascular zone (FAZ) was enlarged more in the right eye compared to left OCT of OU: areas of inner retinal atrophy with paracentral cystoid degeneration and edema		Apixaban 5 mg/day po	-

Eris E. et al., 2017 <sup>26</sup>	Male, 64, left eye	After left leg amputation	Sudden vision loss VA OD = 16/20 VA OS = hand motion RAPD+	Fundoscopy: area of interpapillomacular retinal ischemia with whitish edges and a red spot in the macula OCT: increased reflectivity of the inner retinal layers, central macular thickness = 650 $\mu$ M FA: no perfusion in the macular area with late staining of small veins and arterioles and leakage	Central retinal artery occlusion (CRAO)	Hyperbaric oxygen therapy (20 sessions)	VA OS = 10/200 OCT: macular atrophy
Koban Y. et al., 2014 <sup>27</sup>	Male, 48, right and left eye	After bilateral below-the-knee amputations for ischemic ulcers of the lower limbs Diabetes mellitus (controlled by oral antidiabetics) Left carotid artery stenosis in bilateral carotid artery color doppler ultrasound	Vision loss of OS BCVA OD = 20/20 BCVA OS = 20/32 Ishihara plates OD = 10/10 Ishihara plates OS = 6/10 RAPD+ in OS IOP OD (applanation) = 18 mm Hg IOP OS (applanation) = 16 mm Hg	Gonioscopy OU: open iridocorneal angles to the ciliary body bands for 360 degrees Slit lamp OU: mild posterior subcapsular cataract Fundoscopy OD: arteriolar constriction, minimal pallor of the temporal rim, c/d = 0.5 Fundoscopy OS: relatively superior entrance to the central retinal artery, temporal peripapillary atrophy, arteriolar constriction, retinal edema in the inferopapillary area, splinter hemorrhages, soft exudate, c/d = 0.8 Visual field test: peripheral constriction, decreased retinal sensitivity in the Bjerrum area of the right eye, and a small temporal island FA: delay in inferonasal branch retinal artery filling in the left eye	Acute inferonasal branch retinal artery occlusion in the left eye and bilateral normal tension glaucoma (NTG)	-	-
Korkmaz A et. al, 2018 <sup>28</sup>	Male, 43, left eye	Infrapopliteal artery occlusive disease Occlusion in the right posterior tibial artery Phlebitis migrans	Sudden decrease of VA of OS (duration: 5 days) BCVA OD = 10/10 BCVA OS = 2/10 Ishihara plates OD = 21/21 Ishihara plates OS = 8/21 RAPD+	Fundoscopy: blurring, hemorrhagic swelling of optic disc Humphrey visual field: inferior altitudinal defect FA: late phase - leakage of optic disc	Non-arteritic anterior ischemic optic neuropathy (NAION)	Acetyl salicylic acid (330 mg/d) + Prednisone 1mg/kg/d for 14 days)	After 4 days of treatment: BCVA: 4/10 Ishihara plates: 14/21 Fundoscopy: partially improved disc edema

(Continued)

Table I (Continued).

Authors, Year of Publication	Sex and Age of the Patient on Admission, the Affected eye	Extra-Ophthalmologic Signs and Symptoms and Past History	Symptoms, Signs and Basic Examination on Admission	Results of the Ophthalmic Examination of the Affected eye	Final Diagnosis	Treatment	Outcome
Marques A. et al., 2015 <sup>29</sup>	Male, 64, right and left eye	After amputation of some of the fingers and toes	Progressive bilateral visual acuity decrease and nyctalopia BCVA OD = cf BCVA OS = 0.7	Slit lamp OU: phacosclerosis Fundoscopy OU: extensive confluent areas of chorioretinal atrophy with involvement of the posterior pole (except in the perifoveal area of OS), diffuse arteriolar narrowing FA: delay in the arm-to-retina time (27 seconds), areas of staining; OD – evident exposure of the sclera in the foveal area SD-OCT: reduction in the thickness of the internal and external layers of the retina (except in the fovea of OS) Visual field test: bilateral generalized retinal sensitivity reduction, small central island of vision in OS Flash ERG, scotopic ERG and photopic ERG: extremely diminished amplitudes of both a and b waves	Chorioretinal atrophy	Acetylsalicylic acid 150mg/d	After a year: Maintenance of the VA of OU
Ohguro I. et al., 2006 <sup>30</sup>	Male, 66, left eye	After lumbar sympathectomy After an acute myocardial infarction (1995) Ankle-brachial pressure index: 0.69 (norm: 0.9–1.3)	Progressive visual field disturbance in the left eye VA OD = 1.2 VA OS = 1.5 IOP OU = 13 mm Hg	Slit lamp OU: slight nuclear sclerosis Fundoscopy of OU: retinal vessel tortuosity, arteriosclerosis and glaucomatous cupping c/d of OD = 0.8 c/d of OS = 0.6 Additionally in the fundoscopy of OS: plaques and occlusion in the inferotemporal retinal artery, retinal edema in the inferotemporal area of the macula Humphrey Field Analyzer: decreased retinal sensitivities in the Bjerrum area of OU, retinal artery occlusion area of OS FA: retardation of arm-to-retina circulation time and filling defect of the inferotemporal retinal artery in the left eye	Branch retinal artery occlusion and normal tension glaucoma	-	-

Reche Sainz JA et al., 2018 <sup>31</sup>	Male, 27, right eye	Chronic distal ischemia of the left lower limb (durations: years)	Sudden visual loss VA OD = 0.9 VA OS = no information	Fundoscopy: congestive papilla, cotton wool spots, venous tortuosity, scattered retinal hemorrhages	Papillophlebitis	Acetylic acid (100 mg/d)	VA OD = 1.0 The papilledema and most of retinal hemorrhages have resolved
Zaoui K. et al., 2020 <sup>32</sup>	Male, 30, right eye	Paresthesia of the lower right extremity with intermittent coldness of the feet Necrosis of the right little toe during hospitalization which lead to the amputation	Rapidly progressing visual acuity drop of the right eye and blurred vision of the left eye VA OD = 5/10 VA OS = 10/10	Slit lamp: mixed bilateral granulomatous keratic precipitates with "mutton fat" at the bottom Fundoscopy of OU: multiple, yellow-white spots, greyish pigmented lesions (choroidal lesions) FA: delay in filling the choriocapillary, progressive impregnation of the lesions with slight diffusion per area	Bilateral panuveitis	–	–

**Abbreviations:** OD, oculus dexter; OS, oculus sinister; OU, oculus uterque (both eyes); VA, visual acuity; BCVA, best corrected visual acuity; FA, fluorescein angiography; OCT, optical coherence tomography; ERG, electroretinogram; SD-OCT, spectral domain optical coherence tomography; IOP, intraocular pressure; CDR, cup to disc ratio; RAPD, relative afferent pupillary defect; cf, counting fingers.

**Table 2** The Percentage of Different Types of Ophthalmological Involvement in Patients with Buerger's Disease

Diagnosis	Number	Percentage (Out of 44)
Non-arteritic ischemic optic neuropathy	2	4.55%
Occlusive retinal vasculitis and periphlebitis	1	2.27%
Papillophlebitis	1	2.27%
Central retinal artery occlusion	1	2.27%
Branch retinal artery occlusion	2	4.55%
Normal tension glaucoma	2	4.55%
Uveitis	2	4.55%
Chorioretinal atrophy	1	2.27%
Retinitis	1	2.27%
Papillitis	1	2.27%
Optic atrophy	2	4.55%
Changes typical for atherosclerotic hypertensive retinopathy	22	50.00%
Abnormalities in electroretinography	10	22.73%

by noninvasive vascular testing; exclusion of autoimmune diseases, hypercoagulable states, and diabetes mellitus by laboratory tests; exclusion of a proximal source of emboli by echocardiography and arteriography; and consistent arteriographic findings in the clinically involved and noninvolved limbs<sup>12</sup>. The slightly different criteria were proposed by Papa et al, Mills and Porter or Shionoya.<sup>23,34,35</sup> The reviewed articles were written from the ophthalmological perspective and in many cases the patients had been diagnosed with Buerger's disease prior to the eye problems. That is why the information on the exact criteria on the basis of which Buerger's disease was actually diagnosed is frequently missing.

What needs to be emphasized is that diagnosing thromboangiitis obliterans is based mainly on excluding some other systemic diseases (eg autoimmune diseases). In almost each reviewed article the process of diagnosing was explained in details. Laboratory tests, imaging tests (eg color duplex ultrasound, extremities angiography, photoplethysmographic waveform analysis) and clinical presentation were taken into account. This also explains how the ophthalmological manifestations were attributed to Buerger's disease, as patients suffering from thromboangiitis obliterans are usually thoroughly examined in search for any other comorbidity. That is why the chance of some other disorder causing the involvement of the eye in Buerger's disease is low.

We understand the necessity of providing strict inclusion criteria for Buerger's disease, uniform for all articles and based on the acknowledged classifications. Yet, we could not follow such rigorous methodology because of all articles reviewed in our analysis only two referred to a specific classification of criteria for diagnosing Buerger's disease (Dimopoulos et al and Arslan et al.). In the remaining works the diagnosis was taken for granted as the starting point for further investigation of ocular problems. Some researchers stated that other causes, risk factors or systemic diseases had been excluded (Eris et al, Korkmaz et al, Re-Sainz et al, Zaoui et al, Marques et al.). Ohguro et al mentioned the patient's past medical history. We assumed that the diagnoses of Buerger's disease in the reviewed papers were accurate.

It appears that patients suffering from Buerger's disease may develop non-arteritic anterior ischemic optic neuropathy (NAION), occlusive retinal vasculitis and periphlebitis, papillophlebitis, central retinal artery occlusion (CRAO), branch retinal artery occlusion (BRAO), normal tension glaucoma (NTG), uveitis, chorioretinal atrophy, retinitis, papillitis, optic atrophy, changes typical for hypertensive retinopathy. Additionally, the abnormalities in electroretinography might be present. In the presented cases the occlusion of retinal vessels was the most common ocular manifestation of thromboangiitis obliterans (3 cases: 1 patient with central retinal artery occlusion and 2 patients with branch retinal artery occlusion), followed by normal tension glaucoma (2 cases) and uveitis (2 cases). The first condition mentioned above could be explained by vasospasm and thrombotic occlusion in the course of Buerger's disease.<sup>26,30</sup> Vasospasm may also be responsible for the development of normal tension glaucoma and non-arteritic anterior ischemic optic neuropathy, as it may lead to disturbances in the blood flow within the optic nerve head.<sup>27,28,30</sup> There are studies suggesting an



autoimmune background in thromboangiitis obliterans, which might be connected with the development of uveitis (also an autoimmune disease) in two cases.<sup>32,36,37</sup>

The types of tests which may be useful when examining patients suffering from Buerger's disease mainly depend on the symptoms. However, in many cases fluorescein angiography was conducted and delivered important information. The treatment options and the possible outcome also depend on the type of ocular manifestations, so it seems impossible to propose a universal therapy.

To our knowledge, there seems to be no publication which would discuss all the articles we have managed to find. The most comprehensive review published by Fakour and Fazeli summed up 5 positions.<sup>11</sup> The limitation of our review might be that we did not restrict the time span within which the publications for the analysis were to be found. Only 5 articles were published in the past 5 years. Finally, our inclusion criterion regarding the diagnosis of Buerger's disease in the reviewed works was not based on any specific classification.

## Conclusion

Although the number of publications we have found might not be impressive (13), we need to remember that Buerger's disease is rare and the ocular manifestations in its course are extremely rare. Furthermore, there seems to be no specific features that would make it possible to predict which patient with Buerger's disease is likely to develop ophthalmological complications. The patients described in the review articles did not differ from a typical patient suffering from thromboangiitis obliterans. That is why all patients with this disorder should be treated with caution as potentially at risk for eye problems. Introducing routine eye examination for all patients with Buerger's disease might be helpful. Some of the ocular manifestations of the disorder could be detected during a basic ophthalmic examination comprised of visual acuity and intraocular pressure tests as well as a slight lamp examination. Having analyzed the findings we suspect that Buerger's disease may not be localized vasculopathy but a systemic disease and - like other vasculitis - it may affect various organs and systems. We hope our review may help to raise awareness of possible ocular manifestations in the course of Buerger's disease and encourage physicians taking care of patient with thromboangiitis obliterans to perform ophthalmological examinations.

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## Disclosure

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