



Universiteit
Leiden
The Netherlands

Conjunctival Leiomyosarcoma, a Rare Neoplasm Always Originating at the Limbus? Report of a New Case and Review of 11 Published Cases

Groot, V. de; Verhelst, E.; Hogendoorn, P.C.W.; Keizer, R.J.W. de

Citation

Groot, V. de, Verhelst, E., Hogendoorn, P. C. W., & Keizer, R. J. W. de. (2019). Conjunctival Leiomyosarcoma, a Rare Neoplasm Always Originating at the Limbus? Report of a New Case and Review of 11 Published Cases. *Ocular Oncology And Pathology*, 5(5), 333-339. doi:10.1159/000494497

Version: Publisher's Version

License: [Leiden University Non-exclusive license](#)

Downloaded from: <https://hdl.handle.net/1887/121302>

Note: To cite this publication please use the final published version (if applicable).

Conjunctival Leiomyosarcoma, a Rare Neoplasm Always Originating at the Limbus? Report of a New Case and Review of 11 Published Cases

V. De Groot^{a-c} E. Verhelst^b P.C.W. Hogendoorn^c R.J.W. de Keizer^{a, b}

^aDepartment of Ophthalmology, University Hospital Antwerp, Antwerp, Belgium; ^bAntwerp University, Faculty of Medicine, Antwerp, Belgium; ^cZNA Middelheim Hospital, Antwerp, Belgium

Keywords

Leiomyosarcoma · Conjunctival tumor · Limbus · Eye · Orbit · Soft tissue tumor

Abstract

Purpose of the Study: To describe the differential diagnosis and management of a rare conjunctival malignancy. **Procedures:** A 79-year-old man presented with a conjunctival mass at the limbus. Excisional biopsy revealed a malignant mesenchymal tumor with myogenic differentiation. Six months later, three suspect lesions developed at the border of the previous excision. Pathological diagnosis pointed to a leiomyosarcoma. Adjuvant radiotherapy with strontium-90 brachytherapy was applied. After 3 years, there was neither recurrence nor distant metastases. A literature review revealed 11 cases of conjunctival leiomyosarcoma. **Results:** All 12 cases seemed to originate at the limbal conjunctiva. Scleral invasion was found only in one patient with multiple previous resections. Corneal invasion was reported in two patients. Four patients had a globe-sparing resection. In two of them, margins were not tumor free and additional brachytherapy gave a tumor-free follow-up of 1 and 3 years. Four cases underwent an exenteration. **Conclusion and Message:**

Primary conjunctival leiomyosarcoma is a rare tumor with a favorable prognosis due to early detection and consequently limited size. Diagnosis involves histopathological investigation including immunohistochemistry. If possible, complete resection has the best prognosis. Adjuvant radiotherapy can be effective when the margins are not free and should be considered.

© 2019 S. Karger AG, Basel

Introduction

Leiomyosarcomas are mesenchymal neoplasms, recapitulating smooth muscle cell differentiation. They constitute less than 1% of all malignancies. They are predominantly localized in the retroperitoneum, the inferior caval vein and its major tributaries, the large vessels of the lower extremities, and sometimes at intramuscular and subcutaneous localizations [1]. Diagnosis is often made in an advanced stage and prognosis is usually poor, due to local recurrences and distant metastases.

Primary orbital leiomyosarcomas have been described several times [2–10]. Metastatic leiomyosarcoma to the orbit and choroid have also been reported [11–16]. Until

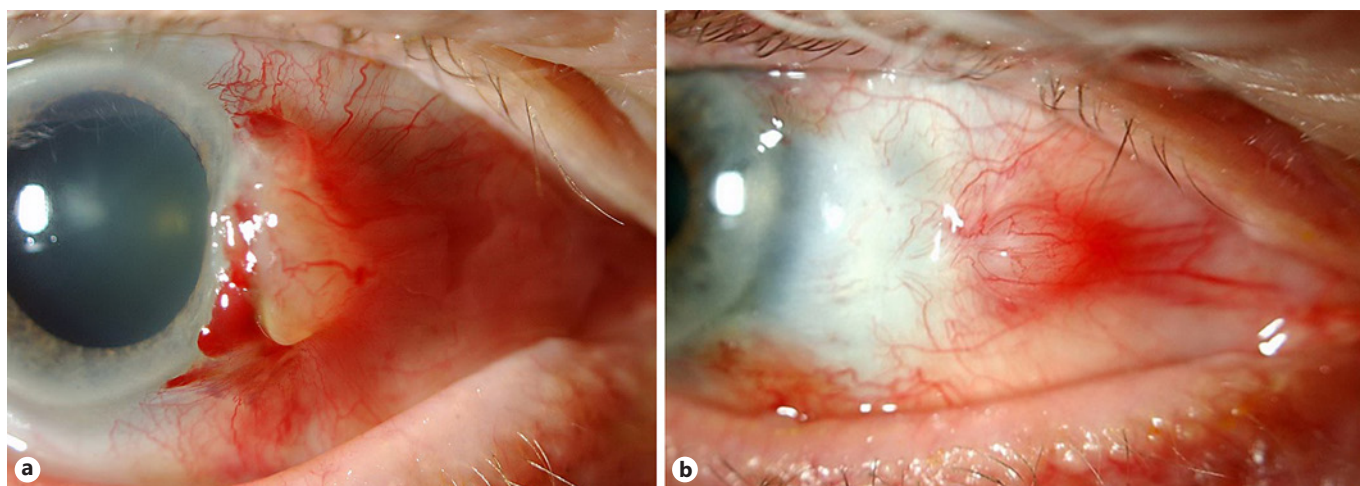


Fig. 1. a Nasal subconjunctival mass on initial presentation. **b** Local recurrences temporal and inferior to previous resection area, 6 months after excisional biopsy.

present, 11 cases of leiomyosarcoma of the conjunctiva have been reported [17–26]. Two of them had anterior orbital invasion [21, 24]. The first report dates from 1976. De Wolff-Rouendaal [17] initially reported a limbal leiomyoma, with recurrence 6 months later, which was subsequently diagnosed as a leiomyosarcoma. We describe a twelfth case of primary conjunctival leiomyosarcoma and review the exact location and outcome of all reported cases.

Patients and Methods

Case Report

A 79-year-old man presented with a 6-month history of redness of the nasal conjunctiva of the right eye with increasing irritation. The conjunctiva at three o'clock, adjacent to the limbus, showed a yellow vascularized mass adjacent to the limbus. On the cornea, there was a small vascular malformation or subepithelial hemorrhage (Fig. 1a). The elevation of the yellow tumor was rather prominent. The lesion was slightly mobile over the sclera, but adherent at the limbus.

Ocular history was negative, although he had an elevated intraocular pressure, being higher in the involved eye with small visual field defects. The pressure responded to topical triple therapy. Medical history revealed ulcerative colitis for 9 months, for which he was taking azathioprine 100 mg and methylprednisolone 6 mg daily.

Excisional biopsy revealed a malignant mesenchymal tumor with moderate myogenic differentiation (diffuse alpha-smooth muscle actin [SMA] immunoreactivity). All other stains (desmin, caldesmon, melan A, HMB45, CK7, CK20) were negative, except for some S100 reactivity and EMA. The specimen was analyzed at the original treating institute and seen in consultation (University

Hospital Antwerp and Leiden University Medical Center), which postponed the diagnosis. Although the biopsy was oriented, resection margins were not determined as priority was given to establish an unequivocal histopathological diagnosis.

Six months after initial excisional biopsy, three suspect lesions developed at all three conjunctival borders around the previous excision (Fig. 1b). After surgical removal, the histopathological diagnosis of 2 lesions was revised as leiomyosarcoma, because of the presence of intersecting bundles of spindle-shaped cells, with cell and nuclear pleomorphism and hyperchromatism combined with eosinophilic cytoplasm. Scattered mitotic figures were observed (Fig. 2). A strong and diffuse immunoreactivity was seen for r-SMA (Fig. 3) and a weak activity for EMA and S100. Desmin, melan A, HMB45, and keratin AE1/AE3 were negative. One margin contained tumor cells.

Adjuvant 60-Gy radiotherapy with strontium-90 brachytherapy was applied (6 sessions of 10 Gy in 1 week). Three years later, the patient had no signs of recurrences (TNM: 1 a N0 M0) [27]. The patient deceased 4 years after diagnosis from an unrelated cause (complication of ulcerative colitis).

Literature Search

A literature search was conducted on PubMed and Web of Science, using the terms leiomyosarcoma, conjunctiva, eye, and orbit. Ten papers describing 11 cases of leiomyosarcoma of the conjunctiva were included [17–26]. Including our case, all 12 cases are summarized in Table 1.

Results

Epidemiology and Medical History

Of the 12 cases, 4 were female and 8 male. Mean age at diagnosis was 53.3 years (range 20–81), with 5 patients

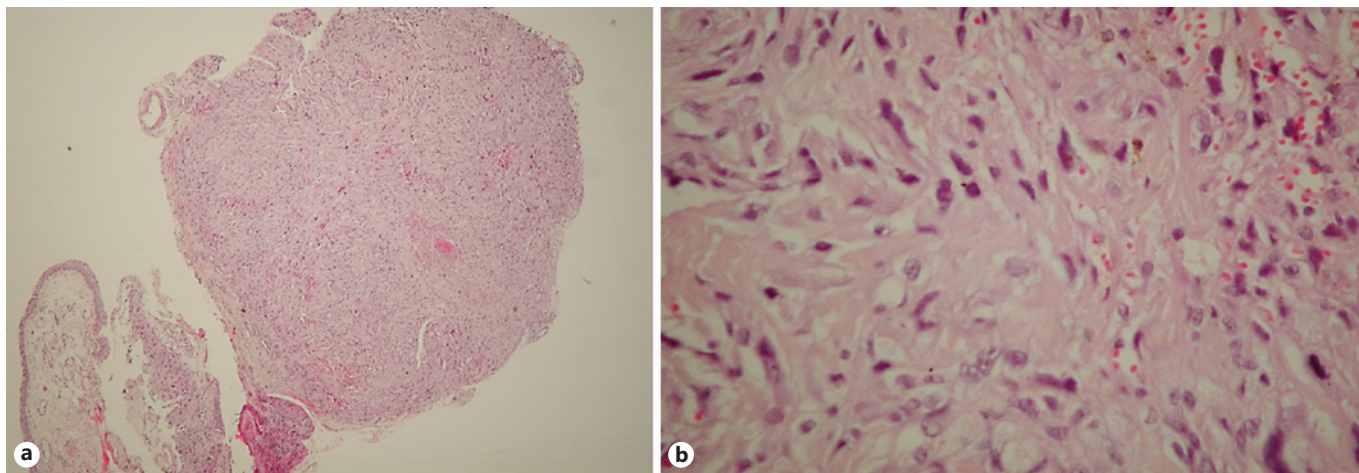


Fig. 2. **a** Overview of the mesenchymal tumor (H&E staining). **b** Spindle-shaped cells, with cell and nuclear pleomorphism (H&E staining, magnification 200×).

younger than 40 years. Laterality was almost equally distributed (7 right eyes, 5 left eyes).

The youngest patient had xeroderma pigmentosa with multiple other tumors [18]. One patient had HIV, without antiviral therapy [26]. Epstein-Barr virus (EBV) infection was specifically excluded in two cases, because of a suspected relation to smooth muscle tumors in immunocompromised individuals [26, 28]. As shown in Table 1, half of the patients initially got a different diagnosis [19, 20], in four of them, including our case, initial pathological diagnosis was not correct [17, 18, 21].

Tumor Location (Table 1)

In 10 of the 12 cases, the authors explicitly describe a subconjunctival lesion located at the limbus, or a picture shows a small lesion at the limbus [22] or both [23, 24]. In the other two larger exophytic lesions also involving fornix or anterior orbit, the initial site of the lesion was reported by the patient to be a small nodule [21, 25]. In order to be visible for a patient, the lesion will be located anteriorly. One of these two had corneal invasion [21]. Both facts are highly suggestive that the tumor also originated from the limbus.

All 12 lesions were located within the palpebral fissure, 7 at the nasal limbus, 1 at the temporal limbus, and in 4 cases, the tumor involved more than half of the limbal circle and the exact site of origin could not be determined.

In two cases, the lesion invaded the cornea. In one patient, it was between the epithelium and the intact Bowman's layer, causing corneal edema necessitating a penetrating keratoplasty leading to the diagnosis [18]. In the

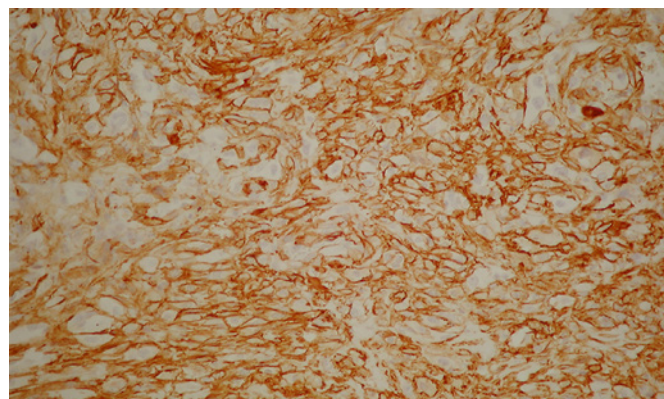


Fig. 3. Staining for alpha-smooth muscle actin (magnification 200×).

other patient, full-thickness stromal invasion was noted, with intact Descemet's membrane [24].

In none of the cases without previous surgery, the sclera was invaded. Even in the very large lesion, the authors describe that the lesion was movable over the scleral plane. Only in the patient with the previous recurrent pterygium resections, the authors mention invasion of the sclera and intraocular tissues [20].

Therapy

Upon diagnosis of leiomyosarcoma, or as excisional biopsy, four patients underwent exenteration, one an enucleation, and one an evisceration. Six patients had a globe-sparing resection. Two of them had clear margins.

Table 1. Patient and tumor characteristics, treatment, and follow-up

First author, year [Ref.]	Sex, age, RE/LE	History	PD	Location	Ins biopsy	Surgery	2nd PD	Adj R/	FU
De Wolff-Rouendaal, 1976 [17]	F 20 LE	-6 m resection limbus, XP	LM	limbus	Mesenchymal LMS?	exenteration	LMS?	-	6 m dead cerebral MMM
White, 1991 [18]	M 44 LE	-26 y limbal nodule	SCC spindle cells	cornea + N+T limbus	LMS	exenteration	LMS + cornea (between Bowman and epithelium)	-	2 y
Yoon, 2006 [19]	M 59 RE	1 y pterygium resection, 2 m red	-	N cornea limbus		excisional biopsy	LMS	-	3 m
Katircioglu, 2011 [20]	M 70 RE	2× pterygium resection	-	exophytic N limbus conj.		enucleation + musculus rectus + conj.	LMS + sclera + transscleral	RT 66 Gy	2 y
Guerriero, 2011 [21]	F 56 LE	years small conj. lesion		5 cm exophytic conj. + fornix + orb + cervical lnn meta	SCC	exenteration	LMS	RT + ChT	Few m dead
Kenawy, 2012 [22]	F 37 LE	8 w lesion pain		limbus SN	LMS	resection + fibers musculi recti complete	LMS	-	1 y
Wan-Wei, 2015 [23]	F 60 RE	2 m fleshy mass		exophytic IN limbus cornea		excisional biopsy	LMS	-	5 m
Nair, 2015 [24]	M 34 RE	2 y white mass		N limbus sup. to inf. + cornea + ant. orbit	LMS	exenteration	LMS + corneal stroma	-	1 y
Nair, 2015 [24]	M 39 LE	4 m		T limbus		excisional biopsy, incomplete base	LMS	ruthenium 80 Gy	14 m
Montes, 2017 [25]	M 81 RE	already 2 y mass conj.		exophytic ant. conj.		evisceration biopsy of sclera and recti: free	LMS	RT 60 Gy	1 y
Wadee, 2017 [26]	M 38 RE	HIV no R/		N conj. limbus onto cornea		monoblock excision complete	LMS		no FU
De Groot [present case] 79	M RE	-6 m N limbal tumor	stromal tumor myogenic diff.	recurrence at resection margins		resection incomplete	LMS	strontium-90 60 Gy	3 y

RE, right eye; LE, left eye; PD, pathological diagnosis; Ins, incisional; Adj R/, therapy; FU, follow-up; XP, xeroderma pigmentosa; w, weeks; m, months; y, years; N, nasal; T, temporal; SN, superonasal; IN, inferonasal; LM, leiomyoma; LMS, leiomyosarcoma; SCC, squamous cell carcinoma; lnn meta, lymph node metastasis; RT, radiotherapy; ChT, chemotherapy; MMM, metastatic malignant melanoma.

One patient had tumor-free follow-up of 1 year [22]. Another patient was lost to follow-up [26]. In two cases, the margins were not discussed but showed a tumor-free follow-up of 3 and 5 months. Two patients with incomplete local resections received adjuvant brachytherapy and re-

mained tumor free for at least 1 and 3 years [24] (Table 1).

Of the 4 patients that needed an exenteration, 2 died; one patient with the largest tumor deceased of related metastatic disease regardless of additional radio- and che-

motherapy [21]. The two patients with enucleation or evisceration with additional resection of part of a rectus muscle received additional radiotherapy and had a tumor-free follow-up of 1 and 2 years [20, 25].

Discussion

Leiomyosarcoma of the conjunctiva is a very rare malignant tumor. In a review of 2,455 conjunctival specimens of adults from Johns Hopkins Eye Pathology Laboratory, no leiomyosarcoma was recorded [29]. In a large series of 1,643 melanocytic and non-melanocytic conjunctival tumors in Wills Eye Hospital in Philadelphia, Shields et al. [30] did not describe any leiomyosarcoma or leiomyoma. Similarly, in other smaller reviews of conjunctival lesions in Montreal [31] (273 specimens, of which 86 tumors), Iran [32] (631 specimens, of which 274 tumors), and India [33] (120 specimens, of which 86 tumors), no single leiomyosarcoma or leiomyoma was identified.

Eleven cases of conjunctival leiomyosarcoma have been reported in the literature, only three of them before 2010. Our case is the twelfth patient. Four of the 12 patients were younger than 40 years, which is young for a deadly disease if not recognized. Males and females were almost equally affected.

A remarkable new element is the tumor location: all lesions were located at the limbus. Most occurred nasally and within the palpebral aperture. This has never been highlighted before. Knowing that the conjunctival surface is very large, it cannot be just a coincidence that all smaller conjunctival leiomyosarcomas were found adjacent to the limbus. Did these lesions originate from the small limbal vessels or did they originate from the pluripotent stem cells present at the corneoscleral limbus? The limbal palisades of Vogt and the interpalisade rete ridges are believed to be repositories of stem cells [34]. Might these poorly differentiated stem cells be the source of this unusual mesenchymal differentiation into spindle cells? The report of corneal invasion between the epithelium and the intact Bowman's layer [18] might be compatible with a tumor originating from these limbal palisades.

Also remarkable is that this aggressive tumor did never invade the sclera in the absence of previous surgery. Even in the very large lesions, the authors describe that the lesion was movable over the scleral plane. Only in one patient with 2 previous recurrent pterygium resections, scleral invasion was documented. Several authors mentioned that the conjunctival epithelium remained intact,

none mentioned otherwise. In the 2 cases of corneal invasion, tumor cells grew between the corneal epithelium and the intact Bowman's layer in one eye, and in the second eye with stromal invasion, Descemet's membranes remained intact. This aggressive tumor does not exhibit an infiltrative growth but seems to respect some anatomical boundaries.

Diagnosis

Macroscopically, it is almost impossible to distinguish a leiomyosarcoma from other non-pigmented conjunctival tumors as lymphoma, dermoids, and carcinomas [22]. We believe that the clinical picture of a subconjunctival tumor, with intact conjunctival epithelium, prominent vascularization with feeding vessels, located near the limbus, and with a rather fast progression, is suspicious for a leiomyosarcoma. Differentiation with amelanotic melanoma remains difficult. An excisional biopsy is mandatory.

Any conjunctival lesion developing in adults should have a histopathological analysis. Especially when spindle cells are seen, a leiomyosarcoma should be excluded. Also, a leiomyoma should be removed completely if possible and followed very closely.

An unequivocal histological diagnosis is not easy on these small biopsies and impossible without immunohistochemical staining. If we look at all 12 cases of conjunctival leiomyosarcoma, 4 were not diagnosed on the first pathological examination, being the first resection or the incisional biopsy.

In all specimens, spindle cells were found arranged in fascicles, with cell and nuclear pleomorphism, eosinophilic cytoplasm, and atypical mitotic figures. The immune reactivity for SMA, muscle-specific antigen, and vimentin proves the smooth muscle origin of the cells and is typical for leiomyosarcoma. Also, h-caldesmon can confirm smooth muscle differentiation and help to further substantiate a diagnosis of leiomyosarcoma, although positive only in about 70% of cases [35].

EBV infection has been associated with smooth muscle tumors [26]. Therefore, the diagnostic algorithm of immunohistochemical stains and in situ hybridization for EBV-encoded ribonucleic acid in the surgically resected tumor tissues as well as blood CD4 count and viral overload estimations for HIV infection can be interesting [36].

Electron microscopy shows the presence of thin cytoplasmatic filaments with fusiform densities, characteristic for smooth muscle fibrils. Electron microscopy has an additional value in excluding the presence of thick cyto-

plasmatic filaments, which are only found in (striated) rhabdomyoblasts, even without sarcomeric organizations (Z-lines) [3, 37, 38]. Currently, electron microscopy is not considered very useful in diagnostics, given the vast array of specific immunostains available nowadays and the rather specific morphologic features at light microscopy. Recently, a comparable case was described with a histopathological diagnosis of myofibrosarcoma [35]. This term is not preferred in the current WHO classification of soft tissue tumors, though in fact it might belong to the group of tumors which we describe here.

Treatment and Prognosis

Leiomyosarcoma in general has an unfavorable prognosis on most locations [39]. The tumor easily disseminates locally and through the blood, with predilection for the lungs, liver, kidney, brain, and skin. Surgery is the first therapeutic treatment for all localized sarcomas. Dependent on the tumor size at diagnosis, wide-margin resection is the intended treatment of choice [39]. Only when the tumor is relatively small and well delineated, a limited extent of surgery can be sufficient to achieve the same result. Adjuvant treatment with radiation and/or chemotherapy is usually not very effective, and no consensus exists regarding the indication of these modalities. Doxorubicin-based chemotherapy is possible as first-line treatment in adults with leiomyosarcoma in which curative surgery is not possible. Doxorubicin and ifosfamide have been reported as an option in the adjuvant setting [40]. When surgery fails, treatment of leiomyosarcoma remains challenging and new therapeutic strategies are waited for [41].

However, the prognosis of leiomyosarcoma of the conjunctiva seems much better, most likely due to early clinical detection. Once a conjunctival leiomyosarcoma is diagnosed, complete wide surgical excision can be curative. If only bulbar conjunctiva is involved, a globe-sparing complete resection can be attempted. If margins are not

clear, adjunctive brachytherapy demonstrated the ability to eradicate the tumor for at least 3 years in our case. In localized disease, radiotherapy is certainly advisable. Only one of the 12 patients, with a very large tumor, died of related metastatic disease. Six patients managed to keep a functional eye.

Conclusion

We present the rare case of a conjunctival leiomyosarcoma. All cases described up to now seem to originate at the limbal conjunctiva. Thanks to early clinical detection, prognosis is much better than other locations of leiomyosarcoma. Complete surgical removal is mandatory. For tumors limited to the bulbar conjunctiva, globe-sparing resection can be attempted. If removal was not radical, adjuvant radiotherapy can be effective in preventing tumor recurrence.

Acknowledgment

The histopathological specimen was also sent for expert histological opinion to the Department of Pathology of Leiden University Medical Center.

Statement of Ethics

The study followed the tenets of the Declaration of Helsinki. The subject gave his informed consent to have the details and photos of the eye published.

Disclosure Statement

None of the authors has any conflict of interest to disclose. None of the authors received sponsorship or funding for this study.

References

- 1 Lazar A, Evans H, Shipley J. Leiomyosarcoma. In: *WHO Classification of Tumours of Soft Tissue and Bone*. Fletcher, CDM Bridge, JA Hogendoorn, PCW et al (eds). Lyon: International Agency for Research on Cancer (IARC) 2013:111–3.
- 2 Begue H, Mawas H. [Leiomyosarcoma of the orbit]. *Bull Soc Ophtalmol Fr*. 1953 May;5: 490–1.
- 3 Jakobiec FA, Howard GM, Rosen M, Wolff M. Leiomyoma and leiomyosarcoma of the orbit. *Am J Ophthalmol*. 1975 Dec;80(6): 1028–42.
- 4 Folberg R, Cleasby G, Flanagan JA, Spencer WH, Zimmerman LE. Orbital leiomyosarcoma after radiation therapy for bilateral retinoblastoma. *Arch Ophthalmol*. 1983 Oct; 101(10):1562–5.
- 5 Wojno T, Tenzel RR, Nadji M. Orbital leiomyosarcoma. *Arch Ophthalmol*. 1983 Oct; 101(10):1566–8.
- 6 Kaltreider SA, Destro M, Lemke BN. Leiomyosarcoma of the orbit. A case report and review of the literature. *Ophthalm Plast Reconstr Surg*. 1987;3(1):35–41.
- 7 Meekins BB, Dutton JJ, Proia AD. Primary orbital leiomyosarcoma. A case report and review of the literature. *Arch Ophthalmol*. 1988 Jan;106(1):82–6.

- 8 Lin IC, Wu CT, Liao SL, Lin LL. Primary orbital leiomyosarcoma. *Ophthalm Plast Reconstr Surg*. 2005 Nov;21(6):451–3.
- 9 Yeniad B, Tuncer S, Peksayar G, Mete O, Minareci O. Primary orbital leiomyosarcoma. *Ophthalm Plast Reconstr Surg*. 2009 Mar-Apr;25(2):154–5.
- 10 Zhou W, Hua F, Qian J, Bi Y, Guan Y. MRI and FDG PET/CT Findings of Primary Orbit Leiomyosarcoma. *Clin Nucl Med*. 2017 Jan;42(1):e71–4.
- 11 Minkovitz JB, Dickersin GR, Dallow RL, Albert DM. Leiomyosarcoma metastatic to the orbit. *Arch Ophthalmol*. 1990 Nov;108(11):1525–6.
- 12 Tijl J, Koornneef L, Eijpe A, Thomas L, Gonzalez DG, Veenhof C. Metastatic tumors to the orbit – management and prognosis. *Graefes Arch Clin Exp Ophthalmol*. 1992;230(6):527–30.
- 13 Voros GM, Birchall D, Ressiniotis T, Neoh C, Owen RI, Strong NP. Imaging of metastatic orbital leiomyosarcoma. *Ophthalm Plast Reconstr Surg*. 2005 Nov;21(6):453–5.
- 14 Su GW, Hong SH. Leiomyosarcoma of the uterus with sphenoid bone and orbital metastases. *Ophthalm Plast Reconstr Surg*. 2007 Sep-Oct;23(5):428–30.
- 15 Chen J, Wei R, Ma X. Orbital metastasis of retroperitoneal leiomyosarcoma. *Med Oncol*. 2012 Mar;29(1):392–5.
- 16 Kim YH, Park IK, Min GE, Jin KH, Shin JH. A Case of Orbital Metastasis of Uterine Leiomyosarcoma With Intracranial Extension Presenting With Proptosis. *Ophthalm Plast Reconstr Surg*. 2016 May-Jun;32(3):e51–2.
- 17 Wolff-Rouendaal D. Xeroderma pigmentosum with ophthalmological symptoms. *Ophthalmologica*. 1976;173(3-4):290–1.
- 18 White VA, Damji KF, Richards JS, Rootman J. Leiomyosarcoma of the conjunctiva. *Ophthalmology*. 1991 Oct;98(10):1560–4.
- 19 Yoon SC, Lee JH, Paik HJ. Adult, Conjunctiva, Leiomyosarcoma, Primary tumor. *J Korean Ophthalmol Soc*. 2006;047:1136–40.
- 20 Katircioglu YA, Altiparmak UE, Kasim R, Ustun H, Duman S. Leiomyosarcoma of the Conjunctiva: case Report. *Turkiye Klinkleri J Med Sci*. 2011;31(6):1544–6.
- 21 Guerriero S, Sborgia A, Giampoli G, Fiore MG, Ross R, Piscitelli D. A rare case of primitive epithelioid leiomyosarcoma of the conjunctiva. *Orbit*. 2011 Jun;30(3):169–71.
- 22 Kenawy N, Coupland SE, Austin M, Damato B. Conjunctival leiomyosarcoma. *Clin Exp Ophthalmol*. 2012 Apr;40(3):328–30.
- 23 Wan-Wei L, Azma-Azalina AA, Sakinah Z, Saleena A, Shatriah I, Zunaina Z. Conjunctival Leiomyosarcoma. *Aperito J Ophthalmol*. 2015;1(2):108, 101–4.
- 24 Nair AG, Kaliki S, Kamal S, Mishra DK, Vemuganti GK. Conjunctival Leiomyosarcoma: A Report of Two Cases. *Orbit*. 2015;34(5):274–8.
- 25 Montes TL, Agra MV, Alonso MS, Lorenzo AO. Conjunctival leiomyosarcoma: A case report and review of literature. *Indian J Ophthalmol*. 2017 May;65(5):406–8.
- 26 Wade R. Conjunctival leiomyosarcoma: A fairly common tumour in an uncommon site. *SAGE Open Med Case Rep*. 2017;5:2050313X17724060.
- 27 American Joint Committee on Cancer. Edge S, Byrd D, Compton C, Fritz A, Greene F, Trotti A: *AJCC Cancer Staging*. Manual 7th Edition. 2010.
- 28 Montes TL. Reply to Conjunctival leiomyosarcoma: A case report and review of literature. *Indian J Ophthalmol*. 2017 Nov;65(11):1266.
- 29 Grossniklaus HE, Green WR, Luckenbach M, Chan CC. Conjunctival lesions in adults. A clinical and histopathological review. *Cornea*. 1987;6(2):78–116.
- 30 Shields CL, Demirci H, Karatza E, Shields JA. Clinical survey of 1643 melanocytic and non-melanocytic conjunctival tumors. *Ophthalmology*. 2004 Sep;111(9):1747–54.
- 31 Alves LF, Fernandes BF, Burnier JV, Zoroquain P, Eskenazi DT, Burnier MN Jr. Incidence of epithelial lesions of the conjunctiva in a review of 12,102 specimens in Canada (Quebec). *Arq Bras Oftalmol*. 2011 Jan-Feb;74(1):21–3.
- 32 Aliakbar-Navahi R, Ashraf MJ, Seirfar N, Koohestani S, Abedi E. Conjunctival Lesions; a Histopathologic Review in Fars Province, Iran. *J Ophthalmic Vis Res*. 2015 Apr-Jun;10(2):98–101.
- 33 Mondal SK, Nag DR, Bandyopadhyay R, Adhikari A, Mukhopadhyay S: Conjunctival biopsies and ophthalmic lesions: A histopathologic study in eastern India. *J Res Med Sci*. 2012 Dec;17(12):1176–9.
- 34 Dua HS, Azuara-Blanco A. Limbal stem cells of the corneal epithelium. *Surv Ophthalmol*. 2000 Mar-Apr;44(5):415–25.
- 35 Platt SM, Schoenfield L, Basti S, Bryar PJ, Goldblum JR, Singh A, et al. Recurrent Conjunctival Myofibrosarcoma Managed With Triple Application of Episcleral Brachytherapy. *Cornea*. 2017 May;36(5):628–30.
- 36 Al-Mendalawi MD. Conjunctival leiomyosarcoma: A case report and review of literature. *Indian J Ophthalmol*. 2017 Nov;65(11):1265–6.
- 37 Kroll AJ. Fine-structural classification of orbital rhabdomyosarcoma. *Invest Ophthalmol*. 1967 Oct;6(5):531–43.
- 38 Morales AR, Fine G, Horn RC Jr. Rhabdomyosarcoma: an ultrastructural appraisal. *Pathol Annu*. 1972;7:81–106.
- 39 Bathan AJ, Constantinidou A, Pollack SM, Jones RL. Diagnosis, prognosis, and management of leiomyosarcoma: recognition of anatomic variants. *Curr Opin Oncol*. 2013 Jul;25(4):384–9.
- 40 Group EE; ESMO/European Sarcoma Network Working Group. Soft tissue and visceral sarcomas: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol*. 2014 Sep;25 Suppl 3:iii102–12.
- 41 Constantinidou A, Pollack S, Loggers E, Rodler E, Jones RL. The evolution of systemic therapy in sarcoma. *Expert Rev Anticancer Ther*. 2013 Feb;13(2):211–23.