

Two 11-Years Periods Statistics and Trends of Enucleation and Evisceration

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Purpose: The indications for evisceration and enucleation are still evolving and controversial. The study aims to describe trends of enucleation versus evisceration in one center.

Methods: In period 1998–2019 were 353 patients were included in the study. Statistical results and Chi-square test for pair-wise comparisons for the statistical significance in comparing two subgroups (years periods 1998–2008 and 2009–2019) per category have been evaluated.

Results: The enucleation was performed in 306 patients, and the evisceration was performed in 47 patients. In 221 patients with the tumor exclusively enucleation was indicated. For the operation technique, the authors got a chi-square value of 0.027, and the associated *P* value is at 0.8695, then the number of evisceration and enucleation in subgroups have not confirmed independency. For the tumor presence, the authors got a chi-square value of 5.4, and the associated *P* value is at 0.02, then the number of validated/nonvalidated tumor presence in subgroups confirmed independency.

Conclusions: The performed enucleations had 98% cases uveal melanoma, 1% of cases of another type of malignancy (lymphoma non-Hodgkin type), and 1% cases with benign tumor. Enucleation is

also today most frequently due to malignant intraocular tumors, whereas evisceration is most frequently for the phthisis eye after a trauma or a previous intraocular surgery. In our study in 22 years interval also in the second period, there was an increased trend of enucleation due to intraocular malignancy. It can have many reasons, especially, that patients are sent to oncology centers late in the advanced stage of tumor.

Key Words: Anophthalmic socket, neovascular glaucoma, orbital surgery, tumors/neoplasms, uveal tumors

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Enucleation, or surgical removal of the entire eye globe, was described by Bartisch in 1583, and was described in combination with orbital volume replacement (implant) by Mules in 1585. In the US, trauma is the leading indication for enucleation (40.9% of cases), followed by tumors (28% of cases). Other indications include painful blind eye, phthisis with degeneration, congenital anophthalmia, severe microphthalmia, unresponsive endophthalmitis, and for improvement of cosmesis in a blind eye.¹

The indications for evisceration and enucleation are still evolving and controversial.^{2,3}

Enucleation is a revolutionary surgery in ophthalmology that includes the perpetual evacuation of the eyeball and is irreversible. Enucleation is typically the last careful arrangement that an ophthalmologist arrives at when all the helpful alternatives for a given determination were done previously. It is generally connected with the extreme evacuation of transcendentally intraocular tumors, yet there are likewise independent gatherings of infections where it is important to continue with enucleation, which for this situation was essential to improve the patient's life.

Enucleation is most regularly acted on account of an intraocular tumor. It is typically utilized in the treatment of intraocular uveal melanoma, which is one of the most well-known essential intraocular tumors in adulthood. Enucleation for retinoblastoma is most normally performed in childhood and adolescence. Besides, we can experience an instance of basal cell carcinoma, which develops into the circle, or the bulbar conjunctiva, and the main treatment choice is enucleation or partial exenteration of the orbit. In any case, it is utilized for any intraocular tumor with a threatening potential that doesn't react to customary treatment or has metastatic potential, causing eye torment or visual impairment.^{4,5}

Enucleation of the eyeball in tumors is demonstrated uniquely in cutting-edge stages. Each enucleated eyeball, resp. every material eliminated during the activity must be inspected in detail histologically.

Enucleations are frequently connected with extreme wounds of the face and this surgery even though the patient is using individual prosthesis, has also psychosocial problems and cosmetic problems.⁶

Enucleation or evisceration can be indicated also for nonmalignant reasons. Such infections likewise incorporate corneal ulcer that starts as a deformity of the epithelium on the outside of the cornea.

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In the event that the irritation isn't distinguished as expected, there is a movement of aggravation; descemetocoele, when an opening is made in the cornea, correspondence happens with the ventricular space, which can result in endophthalmitis. For this situation, enucleation is a day-to-day existence sparing treatment of the best option. Acanthamoeba contamination can cause little microtrauma and thusly can cause descemetocoele affected by collagenolytic catalysts, with conceivable corneal hole. Therefore, endophthalmitis may create. In such serious cases, enucleation is the main conceivable arrangement.⁷

Outright glaucoma is the terminal phase of glaucoma sickness, when the estimations of intraocular pressure are expanded a few times, visual capacities are vanished. For this situation, if torment is available, the finding is made as bulbus dolorosum. With clinical treatment, the condition is not, at this point influenced. Enucleation is the last step to treat the pain.⁸

Eye injury is a gathering that incorporates a wide scope of inclusion of individual eye structures. This is one of the most widely recognized causes of crisis division visits, yet in addition motivations of loss of visual capacity. The most widely recognized kinds of wounds are hole wounds with unfamiliar intraocular bodies, open injuries and wounds or consumes. The most widely recognized signs for enucleation of the eye are hole injury, break of the eyeball, and the subsequent hypotonia, irreversible harm to anatomical structures, loss of visual capacity. Crack is described by hypotension and breakdown of the eyeball with tissue prolapse, hemophthalmus and resulting serious visual disability.^{9,10}

The phtisis of the eye globe is a terminal phase of the sickness, which is described by shrinkage of the eye with complete loss of vision. For this situation, enucleation is the essential arrangement, as the eye has no visual potential and doesn't have the ideal restorative impact.¹¹

MATERIALS AND METHODS

In a 22-years period, from 1998 to 2019, we collected the data of patients at the Department of Ophthalmology, Faculty of Medicine, Comenius University in Bratislava with the information about gender, age, operation technique, and tumor presence due to histopathological findings. The base group we divided into two subgroups per eleven years. The aim was to compare the trends in operation technique and tumor presence in the two followed eleven years periods. The statistical evaluation was based on the comparison of categorical data by including two sets of two categories: operation technique with enucleation and evisceration, and validated/nonvalidated tumor presence. To reject the null hypothesis that values within the defined categories are independent, we performed chi-square test for pair-wise comparisons for the 2 subgroups per category. A *P* value of <0.05 was considered statistically significant.

RESULTS

We collected the data of 353 patients from 1998 to 2019. The median was 64 years, in which the females formed the group of 167 (47.3%, median 65 years) patients and males formed the group of 186 (52.7%, median 62 years) patients. The enucleation was performed in 306 (86.7%, median 64 years) patients, and the evisceration was performed in 47 (13.3%, median 62 years) patients. The further analysis confirmed 221 (62.6%, median 65 years) patients with the tumor, and all these patients underwent exclusively enucleation.

The first subgroup, period 1998 to 2008, includes 109 patients (as shown in Supplementary Digital Content, Table 1, <http://links.lww.com/SCS/C690>) with the median 64 years, in which the females formed the group of 58 (53.2%, median 65 years) patients and males formed the group of 51 (46.8%, median 63 years)

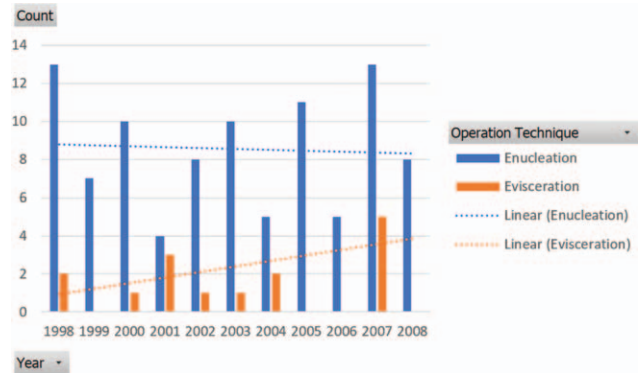


FIGURE 1. Number of patients per year in the first subgroup, period 1998–2008, with trendlines for each operation technique.

patients. The enucleation was performed in 94 (86.2%, median 64 years) patients, and the evisceration was performed in 15 (13.8%, median 62 years) patients (Fig. 1). The tumor was confirmed in 78 (71.6%, median 64.5 years) patients with a tumor (Fig. 3), all these patients underwent exclusively enucleation, in which the number of females was 42 (53.8%, median 68.5 years) and the number of males was 36 (46.2%, median 64 years).

The second subgroup, the period from 2009 to 2019, includes 244 patients (as shown in Supplementary Digital Content, Table 1, <http://links.lww.com/SCS/C690>) with the median 63.5 years, in which the females formed the group of 109 (44.7%, median 65 years) patients and males formed the group of 135 (55.3%, median 62 years) patients. The enucleation was performed in 212 (86.9%, median 64 years) patients, and the evisceration was performed in 32 (13.1%, median 61 years) patients (Fig. 2). The tumor was confirmed in 143 (58.6%, median 67 years) patients with the tumor (Fig. 4) and all these patients underwent exclusively enucleation, in which the number of females was 72 (50.3%, median 67 years) and the number of males was 71 (49.7%, median 66 years).

If we compare medians of patients with confirmed tumors in the first and the second subgroup, see above, then the values document stable age decade with a maximum difference of 2.5 years, that is 64.5 versus 67 in all tumor confirmed patients, 68.5 versus 67 in females, and 64 versus 66 in males.

The statistical evaluation of categorical data (as shown in Supplementary Digital Content, Table 1, <http://links.lww.com/SCS/C690>):

For the operation technique we got a chi-square value of 0.027, and the associated *P* value is at 0.8695. As *P* > 0.05, we cannot

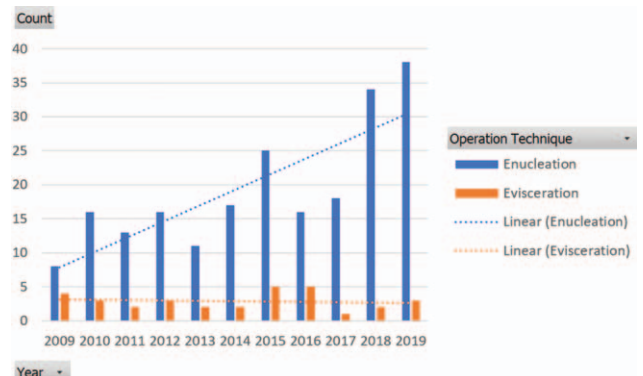


FIGURE 2. Number of patients per year in the second subgroup, period 2009–2019, with trendlines for each operation technique.

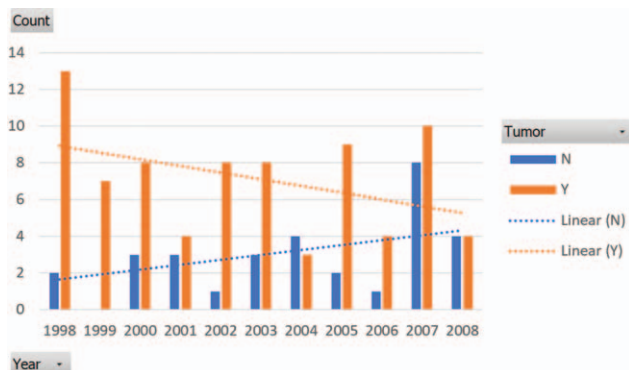


FIGURE 3. Number of patients per year in the first subgroup, period 1998–2008, with trendlines for tumor presence or without tumor.

reject the null hypothesis that number of evisceration and enucleation in the period 1998–2008 and 2009–2019 are independent.

For the tumor presence, we got a chi-square value of 5.4, and the associated *P* value is at 0.02. As *P* < 0.05, we can reject the null hypothesis that number of validated/nonvalidated tumor presence in period 1998–2008 and 2009–2019 are independent (as shown in Supplementary Digital Content, Table 1, <http://links.lww.com/SCS/C690>).

The provided figures with graphs contain in addition trend lines for better visibility:

The enucleation technique: in the first subgroup, period 1998–2008, the number of enucleations shows a slightly decreasing trend (Fig. 1), what is in contradiction to the second subgroup, period 2009–2019, that shows a rapid increasing trend (Fig. 3).

The evisceration technique: in the first subgroup, period 1998–2008, the number of eviscerations shows an increasing trend (Fig. 1), what is in contradiction to the second subgroup, period 2009–2019, that shows slightly decreasing trend.

The tumor presence: in the first subgroup, period 1998–2008, the number of tumor presence shows rapid decreasing trend (Fig. 2), what is in contradiction to the second subgroup, period 2009–2019, that shows rapid increasing trend (Fig. 4).

The cases without tumor: in the first subgroup, period 1998–2008, the number of cases without tumor shows slight increasing trend (Fig. 2), what is similar to the second subgroup, period 2009–2019, that shows also slight increasing trend (Fig. 4).

In the patients with combined methods (enucleation plus partial exenteration of the orbit) in the period 1998–2019 the 95% cases had the indication due to basal cell carcinoma primary origin from the eyelids.

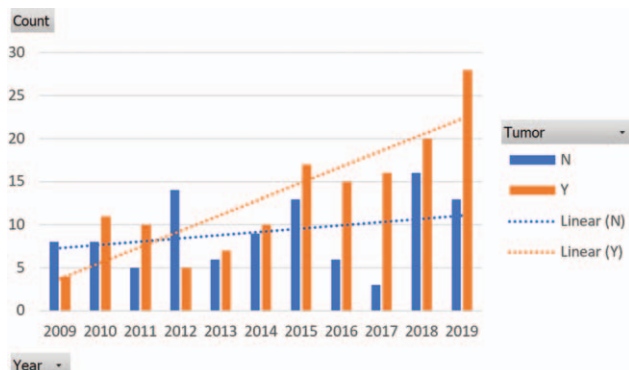


FIGURE 4. Number of patients per year in the second subgroup, period 2009–2019, with trendlines for tumor presence or without tumor.

In patients with enucleation in the period 1998–2019 the 98% cases had the indication for radical surgery uveal melanoma, the 1% cases had another type of malignancy (lymphoma non-Hodgkin type), and the 1% cases had a benign tumor (hemangioma, neurofibroma).

DISCUSSION

Ocular enucleation is accounted as the last resort for end stages of many ocular diseases like ocular malignancies or other clinical causes leading to a painful blind eye. Evisceration is another alternative which is mainly a cosmetic procedure and is used when a malignancy does not exist.¹²

In the study of Valeshabad ocular injuries and malignancies were 2 main causes of enucleation which were matched with initial indication of surgery. Disfiguring a painful blind eye was the most common indication of surgery, followed by leukocoria and endophthalmitis. The postoperative complication rate was high in enucleated eyes who received HA implants.¹³

If we compare data from the 20th Century in children’s age the frequency of the causes for enucleation is trauma (55%), retinoblastoma (21%), inflammation and infection (12%), and congenital or developmental diseases (10%). Still today trauma is the most frequent cause for enucleation except in the first 3 years of life, when retinoblastoma is the most common.¹⁴

Enucleation is a topic discussed in psychiatry which is a self-injury matter. Enucleation is observed as psychotic disorder due to substance abuse. In people with mental disorders who also have substance use leading to hallucinations and delusions, unusual eye evacuation was reported. In most cases, enucleation was done using sharp tools.¹⁵

There are many techniques described how to perform enucleation, for example, a cryotherapy probe to induce proptosis during enucleation surgery.¹⁶

Residual orbital melanoma (extrascleral extension) is associated with increased risk of metastasis and poor prognosis. Postenucleation external beam radiation therapy has been employed to reduce local recurrence and improve survival. However, such orbital external beam radiation therapy has been associated with eyelash loss, eyebrow loss, socket deformity, and dry eye. Alternatively, this study examines the results of a clinical case series of patients treated with iridium-192 high dose rate brachytherapy.^{13,17}

Ophthalmology has gained critical ground in explaining wounds, just as malignant growth, however extreme medical procedure, for example, enucleation or gutting still has its place in showed cases. Indeed, even in the present current period of medication, we actually don’t need to utilize such extremist surgeries, however at times it depends on an intense condition, yet it additionally happens that patients search out a corrective ophthalmologist after wounds or rehashed tasks. The loss of an organ significantly affects the patient’s mind. In our work, we broke down the consequences of enucleations and guttings in a gathering of our patients, and we found, as in different work environments, a higher number of enucleations for wounds in males than in females, which might be identified with their work or sports exercises.^{9,18}

The specialist’s choice in extreme wounds for enucleation or gutting can be controlled by a few elements; notwithstanding, a few working environments lean toward destruction predominantly for corrective reasons in patients, where patients are dependably followed up to decrease the occurrence of thoughtful ophthalmia.⁹

In intense conditions, we generally make progress toward essential stitch, however out of the absolute number of 11 years, we needed to continue fundamentally with enucleation or gutting in 8 patients. Three patients went through enucleation for injury and one killed, one destroyed the day after waterfall medical procedure for endophthalmitis, and two for punctured ulcer cornea engraved

the eyeball. One patient was explicit in that he was admitted to our clinic with an analysis of eyeball separation. One of the patients with enucleated eye had histologically affirmed intraocular neurofibroma. Of the complete number, a versatile prosthesis was stitched during enucleation in 13 patients and in 3 with gutting.

In patients with military wounds, the extent of enucleations is the equivalent in extreme wrecking eye wounds, however, the level of thoughtful ophthalmia is low in both surgeries.¹⁹

Notwithstanding huge advances in the treatment of corneal ulcer and new methods and systems in eye microsurgery at times, it is important to move toward an extreme arrangement in the last stage (gutting, enucleation). In the study of Hongyok, they reported 100 patients who underwent this type of radical surgery.²⁰

Enucleation in patients with essential intraocular tumors has been supplanted in late a long time by different types of radiotherapy and consolidated strategies with nearby tumor resection. Uveal melanomas influence 2 to 8 million Europeans every year. Roughly 35% are treated by enucleation. Proton beam radiotherapy might be an option in contrast to enucleation in patients who don't agree to enucleation.²¹ Regardless of revolutionary enucleation treatment, the quantity of patients who create metastases and end lethally is still as high as half.²² There stays a worry that if choroidal dangerous melanoma is little and undiscovered in light of its size, it might make the tumor metastasize and the patient will kick the bucket sooner contrasted with if the tumor is bigger and conclusion and treatment quicker. The endurance of patients after essential enucleation for the tumor cycle; harmful uveal melanoma or after radiosurgical systems is not extraordinary.^{23–27}

The personal satisfaction after eye removal is additionally controlled by the restorative impact and is significant for the patient. In an examination in Ireland of 138 patients out of 206 patients who finished a personal satisfaction poll after enucleation or brachytherapy for uveal melanoma, there were no critical contrasts between the 2 gatherings.²⁸ It ought not to be failed to remember that notwithstanding appropriate determination and treatment, it is important to focus on the mental results in patients after enucleations or destructions.^{29–33}

Enucleation is still a very important surgical technique in intraocular tumors patients. In a review study from 1990 to 2000, Cohen et al³⁴ analyzed 196 patients with choroidal melanoma. A total of 78 patients were treated with stereotactic radiosurgery and 118 treated with enucleation. Compared to 74% in the stereotactic treatment group the 5-year cumulative metastasis-free survival rate was 51% in the enucleation treatment group. And there was no statistical difference in survival rates between the two treatment groups. Tumor location, ciliary body, and tumor volume were the variables that influenced survival rates. Large ciliary body tumors had the highest risk of metastasis but metastasis-free survival after stereotactic irradiation was similar to that after enucleation.

In the past the studies reported survival following time after enucleation for intraocular uveal malignant melanoma did not contain cumulative survival rates and did not use a multivariate analysis. But In the study of 340 patients, there was no loss to follow-up 6 to 22 years after enucleation. In final evaluation of the study in 233 patients (68.5%) died but only 137 (40.3%) of intraocular melanoma-related causes. Melanoma-related deaths appeared from 24 patients. The cumulative 5-year survival proportion based on melanoma-related deaths was 70% and the corresponding 10-year proportion was 56%. Multivariate Cox regression indicated that the largest tumor dimension, tumor location, and cell type had independent prognostic value. Large tumors were more common in the anterior choroid or ciliary body but in the posterior part of the eye globe. This investigation affirmed that the biggest tumor size and tumor area are autonomous prognostic components.³⁵ In the investigation of Furdova et al there was no difference

in survival in patients after enucleation and after irradiation with a radiosurgical strategy.^{36–39}

Secondary enucleation for melanoma is more uncommon and in certain patients, enucleation happens after earlier light for resulting complexities. In the study of long-term results of single-dose one-day session stereotactic radiosurgery for intraocular uveal malignant melanoma in 170 patients treated in one center the median overall follow-up time was three years and the median tumor volume at baseline was 0.5 cm³. The survival after single dose one-day session stereotactic radiosurgery was 96% 1 year after therapy, 93% in 2 years, 84% in 5 years, 80% in 7 years and 52% in 11 years. Secondary enucleation/enucleation after irradiation was necessary for 22 patients due to glaucoma complications (13%). The enucleation-free interval ranged from 1 to 6 years.³⁹

Enucleation due to intraocular tumor, especially uveal melanoma, is still comparable to other treatment techniques. In our study in 22 years interval also in the second period, there was an increased trend of enucleation due to intraocular malignancy. It can have many reasons, especially, that patients are send to oncology centers late in advanced stage of tumor.

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