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# Survey of Ehlers–Danlos Patients' ophthalmic surgery experiences

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**Abstract**

**Background:** Ehlers–Danlos Syndrome (EDS) is a rare disease affecting approximately 1 in 5,000 people. Although ophthalmic conditions associated with EDS have been described, little data exist concerning ophthalmic surgical outcomes experienced by EDS patients.

**Methods:** Patients with EDS were surveyed via the EDS Society and asked about their ophthalmic surgical experiences including procedure, complications, and the timing with respect to receiving the EDS diagnosis. Complications were confirmed as such by subspecialists.

**Results:** Of 579 respondents, 467 reported confirmed EDS, and 112 of those had an ophthalmic procedure, including refractive surgery, cataract/lens surgery, retinal surgery, strabismus surgery, oculoplastic surgery, corneal surgery, and laser surgery for glaucoma. The rate of confirmed complications was: 23%-refractive, 33%-lens/cataract, 33%-retina, 59%-strabismus, 23%- oculoplastics, 0%-cornea, and 25%-glaucoma laser. In addition, 76% of patients underwent surgery prior to the EDS diagnosis.

**Conclusions:** Patients with EDS may have elevated risk of postoperative ophthalmic surgical complications. It would seem reasonable to systemically and prospectively explore how patients with EDS respond to ophthalmic surgery. Furthermore, it would seem circumspect to ask surgical candidates patients about whether they carry a diagnosis of EDS or have signs and symptoms of EDS prior to surgery.

**KEYWORDS**

complication, Ehlers–Danlos, eye, ophthalmology, surgery

## 1 | INTRODUCTION

Ehlers–Danlos Syndrome (EDS) is a group of 13 genetically transmitted connective tissue disorders that affect approximately 1 in 5,000 people worldwide (Loeys, 2016). Ocular involvement of EDS (Brady et al., 2017) has been described. For example, EDS patients have a higher likelihood of developing certain ophthalmic conditions such as

epicanthic folds, strabismus, and myopia (Beighton, 1970) and can demonstrate thin corneas and reduced tear secretion (Bowen et al., 2017). As such, they may be particularly prone to ocular injury and therefore these patients and their physicians have a need to know whether eye surgeries pose additional risks for them compared to the general population. In the present study we surveyed patients with EDS who have had eye surgeries and asked them to catalog their experiences including complications.

## 2 | METHODS

We collaborated with The Ehlers–Danlos Society to circulate an online survey among the EDS community (Supplement 1). The survey was announced by The Ehlers–Danlos Society and was further distributed by social media. The survey was open to respondents from 10 April 2018 until 11 July 2018. We collected information on patient demographics (birth sex, age as of January 2018), EDS diagnoses (age at diagnosis, EDS subtype), ocular health (ocular diagnoses), and eye surgeries (complications/subsequent surgeries, and whether surgeries took place before or after the patient was diagnosed with EDS). The survey also featured an open-ended section for respondents to further elaborate on their surgical experiences, which were then analyzed by ophthalmic subspecialists relevant to the type of surgery. All responses were anonymous and the database of results is available upon request from the corresponding author. This research was approved by the Johns Hopkins School of Medicine Institutional Review Board.

## 3 | RESULTS

The survey received responses from 579 patients with suspected or geneticist-confirmed EDS (467 confirmed, 102 suspected). In this study, we chose to analyze only the data given by geneticist-confirmed ED patients. The 467 respondents with confirmed EDS reported their EDS subtype: (Classic: 11; Classical-like: 11; Cardiac-valvular: 5; Vascular: 11; Hypermobile: 406; Arthochalasia: 1; Dematosparaxis: 2; Kyphoscoliotic: 1; Spondylodysplastic: 1; Musculocontratural: 1; Myopathic: 9; Periodontal: 5; Unsure: 30). It should be noted that of the 13 defined EDS subtypes as defined by the latest international classification criteria (Malfait et al., 2017), 12 were represented since no patients described having Brittle Cornea syndrome. In addition, some patients were unsure of their exact diagnosis and provided several suspected subtypes. The ages of respondents with confirmed EDS ranged from 6 to 77 years (mean 31.4). Age at diagnosis ranged from 0 (at birth) to 70, with a mean age of 37.7 years as of January 2018. Respondents identified their birth sex as male (20) or female (447).

Of the 467 patients with confirmed EDS, 112 (24.0%) underwent some type of ophthalmic surgery (including refractive surgery, strabismus surgery, cataract/lens surgery, oculoplastic surgery, cornea surgery, laser surgery for glaucoma, iridotomy, intraocular injection, or a glaucoma shunt). Out of those 112, 51 (45.5%) described at least one complication. Table 1 shows the types and numbers of surgeries as well as the number and proportion of complications reported. Surgeries for which there were fewer than four instances (gray highlight on table) were not analyzed in detail; this included

**TABLE 1** For the 112 patients with confirmed EDS, this table lists the surgeries reported as well as the numbers of complications and the calculated rates of complications

| Types of surgery | Total surgeries | Reported complications | True complications | True complication rate | Surgery BEFORE dx | % surgery BEFORE dx |
|---|---|---|---|---|---|---|
| Refractive | 43 | 16 | 10 | 23.3% | 34 | 79.1% |
| Cataract/Lens | 21 | 10 | 7 | 33.3% | 8 | 38.1% |
| Retina | 18 | 6 | 6 | 33.3% | 11 | 61.1% |
| Strabismus | 17 | 10 | 10 | 58.8% | 14 | 82.4% |
| Oculoplastics | 13 | 5 | 3 | 23.1% | 9 | 69.2% |
| Cornea | 5 | 3 | 0 | 0.0% | 2 | 40.0% |
| Laser surgery for glaucoma | 4 | 1 | 1 | 25.0% | 1 | 25.0% |
| TOTAL | 121 | 51 | 43 | 35.5% | 79 | 65.3% |
| Iridotomy (laser or surgical) | 4 | 3 | 3 | 75.0% | 0 | 0.0% |
| Intraocular injection | 1 | 1 | 1 | 100.0% | 1 | 100.0% |
| Glaucoma shunt | 1 | 1 | 1 | 100.0% | 0 | 0.0% |
| Trabeculectomy | 0 | 0 | 0 | *n*/a | 0 | *n*/a |

*Note:* Procedures with fewer than four occurrences are highlighted in gray and are not included in discussions of complication rates.

iridotomies, intraocular injections, trabeculectomies, and glaucoma shunting procedures. Below are the results from each individual category of surgery.

### 3.1 | Refractive surgery

Forty-three patients underwent refractive surgeries (including radial keratotomy [RK], photorefractive keratectomy [PRK], laser assisted in-situ keratomileusis [LASIK], and laser epithelial keratomileusis [LASEK]) out of which 34 (79.1%) underwent surgery before receiving their EDS diagnosis and 16 reported surgical complications (37.2%). Note that two (4.7%) respondents did not specify their complications, while some respondents listed multiple complications, so the number of complications below does not add up to the number of surgeries/respondents.

Eight patients (18.6%) reported under-correction and regression, four patients (9.3%) reported postoperative pain, three patients (7.0%) reported night vision or halos, two patients (4.7%) reported dry eye, one patient (2.3%) reported residual astigmatism and three more patients (7.0%) reported induced/acquired astigmatism, two patients (4.7%) reported what seemed to be possible corneal ectasia (although this was not entirely clear based on the description), and one patient (2.3%) reported LASIK flap striae.

### 3.2 | Cataract/lens surgery

Twenty-one patients underwent lens surgeries (including cataract removal, capsulotomy, and implantation of artificial lens), out of which 8 (38.1%) underwent surgery before receiving their EDS diagnosis and 10 (47.6%) reported surgical complications. Note that one (4.8%) respondent did not specify their complications. One patient (4.8%) reported retinal detachment, 1 patient (4.8%) reported pigment dispersion syndrome (PDS), 1 patient (4.8%) reported a wound leak, 1 (4.8%) patient reported diplopia, 1 patient (4.8%) reported dry eye, 1 (4.8%) patient reported posterior vitreous detachment (PVD), 2 (9.5%) patients reported posterior capsular opacification (PCO), and 1 (4.8%) patient reported floppy iris. We deemed that floppy iris and PCO were not true complications, bringing the complication rate down to 33.3%.

### 3.3 | Retina surgery

Eighteen patients underwent retina surgeries including repair of retina tears, holes, or detachments, out of which 11 (61.1%) underwent surgery before receiving their EDS diagnosis and 6 (33.3%) reported surgical complications. Two subjects did not specify their complications. The remaining four (20.0%) all reported repeated retinal detachment.

### 3.4 | Strabismus surgery

Seventeen patients underwent strabismus correction surgeries, out of which 14 (82.4%) underwent surgery before receiving their EDS diagnosis and 10 (58.8%) reported surgical complications, with 3 patients reporting repeat surgeries and another reporting recurrence of strabismus (23.5%), 1 patient (5.9%) reported a potential case of central binocular diplopia, 1 (5.9%) patient reported strabismic amblyopia, 1 (5.9%) patient reported slow recovery, 1 (5.9%) patient reported overcorrection, and 1 (5.9%) reported lack of binocularity. An additional patient (not counted in the above listing) reported complications deemed to be unassociated with strabismus surgery, reporting "stars around the periphery of [their] vision." The final patient did not specify their complication.

### 3.5 | Oculoplastic surgery

Thirteen patients underwent oculoplastic surgeries (including growth removals, tear duct surgeries, optic nerve sheath fenestration, and ptosis), out of which 9 (69.2%) underwent surgery before receiving their EDS diagnosis and 5 (38.5%) reported surgical complications, including 2 (15.4%) patients reporting the need for repeat ptosis, 1 (7.7%) patient reporting that the "plugs began scratching eyes" relating to an insertion of a punctum plug, 1 (7.7%) patient reporting floppy eyelid following optic nerve sheath fenestration, and 1 (7.7%) patient reporting headaches due to head positioning during surgery (due to separate diagnosis of Chiari Malformation). We did not include the floppy eyelid nor the headaches as true complications, leaving a complication rate of 23.1% (more information in the discussion section).

### 3.6 | Cornea surgeries

Five patients underwent cornea surgeries (including corneal transplants and repairs), out of which two (50.0%) underwent surgery before receiving their EDS diagnosis and three (60.0%) reported a surgical complication.

### 3.7 | Laser surgery for glaucoma

Four patients underwent laser surgeries for glaucoma, out of which 1 (25.0%) underwent surgery before receiving their EDS diagnosis and 2 (50%) reported surgical complications.

Note that one patient chose not to report time of EDS diagnosis. One (25.0%) patient reported surgical complications, specifically a "long healing process."

# 4 | DISCUSSION

## 4.1 | Refractive surgery

### 4.1.1 | Undercorrection/regression

Eight patients (18.6% of all patients who underwent refractive surgery) reported under correction or regression, which could either refer to postoperative residual refractive error, regression of initially successful refractive correction over time, or a true poor surgical outcome. Although residual refractive error after laser vision correction is not uncommon in postoperative patients, with previous studies showing residual refractive error rates in as many as 97.2% of postoperative eyes, its effects are usually small and functionally insignificant (Sandoval et al., 2016). Regression of the initially achieved refractive correction also has been a widely observed phenomenon following LASIK since its inception more than two decades ago. With technological advances in laser refractive surgery and various proposed management strategies, post-LASIK regression rates are now around 5% (Albietz, Lenton, & McLennan, 2004; Yan, Chang, & Chan, 2018).

### 4.1.2 | Postoperative pain

Four patients (9.3%) reported postoperative pain. Early pain, tearing, and light sensitivity are common after LASIK, and in previous studies, 95% of patients reported pain the first day after surgery (F Torres et al., 2007). In a small number of patients, chronic pain may be a symptom of aberrant healing of the corneal nerves, although this is rare and we did not collect information on the duration of postoperative pain. In future studies, we plan to reach out to these patients again and acquire more specific details, but for the current study it may be reasonable not to include the complaint of postoperative pain as a complication.

### 4.1.3 | Impaired night vision/halos

Three patients (7.0%) reported impaired night vision or halos. Subjective quality of vision, including visual fluctuations, reduced contrast sensitivity, night vision disturbances (halos, starburst, glare, etc.) are common in the early healing period after LASIK. Less than 1% of patients in previous studies experienced impaired night vision and halos (combined), and out of these patients, the symptoms were still alleviated by the surgery (symptoms caused patients more difficulty preoperatively than postoperatively) (Sandoval et al., 2016). We recommend we follow-up with these patients to ask them more about their experience with the symptoms preoperatively.

### 4.1.4 | Dry eye

Two patients (4.7%) reported dry eye. Dry eye is the most frequent complaint after LASIK, occurring in 95% of patients and fortunately resolving in the vast majority within the first postoperative year (Shtein, 2011). Persistent dry eye that lasts beyond a year is less common, but our survey did not collect information for length of dry eye (besides one patient who specifically referred to their condition as "chronic dry eye"). It may be reasonable not to include the complaint of dry eye as a complication for this study.

### 4.1.5 | Induced/acquired astigmatism

Three patients (7.0%) reported induced or acquired astigmatism or flipped axis. In comparison, another study comparing outcomes of PK and LASIK showed that 9.5% of eyes in the PK group and 2.1% of eyes in the LASIK group experienced an increase of 1.25 D or more 6 months after operation (Hersh, Fry, & Bishop, 2003), a visual indicator of induced astigmatism. One patient (2.3%) reported residual astigmatism, also known as astigmatic regression. A previous study showed that 97.6% of all eyes underwent a second surgery to correct residual myopia, showing that residual astigmatism is fairly common (Hersh et al., 2003).

### 4.1.6 | Corneal ectasia

Two patients (4.7%) reported potential corneal ectasia (although this was not entirely clear based on the open-ended descriptions). One patient wrote about their difficult experience with finding contact lenses, signifying an abnormal cornea shape that could be indicative of ectasia (although the patient did not specify whether these difficulties occurred before and/or after the surgery). The second patient wrote about their second surgery for a piggyback lens, which could again be the result of an abnormal cornea shape and ectasia. Corneal ectasia is a recognized risk of LASIK. Indeed, EDS is considered a contraindication to LASIK given the collagen abnormality and reported incidence of keratoconus or keratoglobus in certain subtypes. Iatrogenic keratoectasia has been reported in a patient with benign joint hypermobility syndrome (Galperin, Berra, & Berra, 2014).

#### 4.1.7 | LASIK flap striae

One patient (2.3%) reported a LASIK flap striae, specifically writing there were "folds in the flap" and "minor infection." This can be macrostriae, caused by malpositioning of the flap with significant visual effects that need to be addressed by flap revision, or microstriae, which are visible upon examination but are not clinically or visually significant. Comparatively, fine striae has been found in up to 40.3% of eyes post-LASIK (Vesaluoma et al., 2000).

Refractive surgeries are overall considered a very safe, successful procedure, with LASIK patient satisfaction rates of 95% and reports with modern technology showing that 90.8 of patients achieve uncorrected distance visual acuity (UDVA) of 20/20 or better, and 99.5% achieved a UDVA of 20/40 or better (Sandoval et al., 2016). Complication rates in the general population are around 1.19% (Yuen, Chan, Koh, Mehta, & Tan, 2010). Comparatively, excluding the six patient complaints that might not be true complications, the complication rate for the cohort of EDS patients surveyed was 23% (10/43).

### 4.2 | Cataract/lens surgery

Overall, it would appear that of the nine reported complications, two were not considered true surgical complications, leaving a complication rate for cataract/lens surgery of 33.3% (7/21). Cataract surgery is generally considered a safe surgery, with follow-up studies at 26+ weeks postoperation showing 93% of eyes with good outcomes. However, there is a significant recovery period, with only 23% of patients presenting with good immediate postoperative outcomes, although 55%–75% of these poor outcomes shift to good outcomes by 6 months postoperation (Limburg et al., 2005). It is possible we surveyed patients who were still in the early postoperative period and may still be recovering.

#### 4.2.1 | Retinal detachment

One patient (4.8%) reported retinal detachment. After cataract extraction, the incidence of retinal detachment has been estimated to range between 0.6% and 1.7% during the first postoperative year (Coppé & Lapucci, 2008). Previous case studies show EDS patients generally experience retinal detachment seemingly in conjunction with their EDS symptoms, although no rigorous studies have been conducted on the specific occurrence rates after cataract/lens surgery (Akpinar, Gogus, Talu, Hamzaoglu, & Dikici, 2002; Malfait et al., 2013).

#### 4.2.2 | Pigment dispersion syndrome (PDS)

One (4.8%) patient reported pigment dispersion syndrome (PDS). The patient received a piggyback lens. It was unclear from the survey response whether the PDS began after the first IOL or was a complication of the piggyback lens. It is with caution that we report pigment dispersion as a complication, as it is typically a separate syndrome not caused by cataract/lens surgeries. There have only been a few case studies done in which a piggyback IOL procedure has seemingly resulted in PDS (Brandt, Mockovak, & Chayet, 2001; Canut Jordana, Pérez Formigó, Abreu González, & Nadal Reus, 2010; Chang et al., 2007).

#### 4.2.3 | Wound leak

One patient (4.8%) reported a wound leak, described as a "slow leak of blood [that] healed slowly." Wound leaks during surgery are very common (around 97.6% of eyes leak spontaneously during surgery), and range from about 4.1%–34.1% in the month following surgery, depending on surgical technique (Masket et al., 2014). Wound leaks typically do not have any adverse effects but are a risk factor for infection (Masket et al., 2014).

#### 4.2.4 | Posterior vitreous detachment (PVD)

One patient (4.8%) reported posterior vitreous detachment (PVD). Previous studies show that the cumulative 3-year incidence of new PVD after cataract surgery was 30% (Hikichi, 2012).

#### 4.2.5 | Diplopia

One (4.8%) patient reported diplopia. Most large series describe the incidence of diplopia after cataract extraction as between 0.17% and 0.75% (Bouffard & Cestari, 2018). Although diplopia is a noted complication postcataract surgery for patients with strabismus (Hamed, Helveston, & Ellis, 1987), the patient who reported diplopia did not report strabismus as one of their ocular diagnoses and it is unclear if they meant monocular or binocular diplopia.

#### 4.2.6 | Dry eye

One (4.8%) patient reported dry eye. Phacoemulsification surgery may aggravate the signs and symptoms of dry eye and affect dry eye test values in chronic dry eye patients in short term. However, in the long term, signs and symptoms

of dry eye decrease and dry eye test values return to preoperative values (Cetinkaya et al., 2015). It may be that this complaint should not be considered a complication.

#### 4.2.7 | Noncomplications

Two patients (9.5%) reported posterior capsular opacification (PCO), the most common complication following primary cataract surgery with intraocular lens implantation. Rate varies depending on surgical technique, lens type, material, patient age, and other factors, but the overall incidence of PCO or YAG capsulotomy is somewhere between 15% and 33% (Schmidbauer et al., 2001). PCO is considered a "textbook" complication, but in practice happens frequently enough that ophthalmologists do not necessarily find it concerning. We chose not to count these patients as having complications.

An additional patient (4.8%) reported floppy iris, which is not a complication of surgery but rather can complicate surgery. Floppy iris can occur idiopathically (Tzamalis, Matsou, Dermenoudi, Brazitikos, & Tsinopoulos, 2019) and can also occur in patients using certain medications (Wahl, Tipotsch-Maca, & Vecsei-Marlovits, 2017). Intraoperative floppy iris syndrome (IFIS) occurs in 2% of cataract surgeries (Enright, Karacal, & Tsai, 2017). There are no reports that floppy iris might be associated with EDS.

### 4.3 | Retina surgeries

Eighteen patients underwent retina surgeries including repair of retina tear holes or detachments, out of which 6 (33%) reported surgical complications. Four patients (22%) reported recurrence of their retinal detachment. After retinal surgeries, previous studies show that up to 47% of eyes experience residual retinal detachment, although around 87% of these eyes spontaneously reattach within a year (Hagimura, Iida, Suto, & Kishi, 2002).

It is interesting to note that our retinal surgery subjects were all under the age of 40; the National Eye Institute considers being 40 or older as one of the main risk factors of detachment. However, another study found age had no statistical significance in retinal detachments (Chignell, Fison, Davies, Hartley, & Gundry, 1973).

### 4.4 | Strabismus surgery

Seventeen patients underwent strabismus correction surgeries, out of which 10 (59%) reported surgical complications. One reported slow recovery without additional details. EDS has historically been linked with higher rates of strabismus (Beighton, 1970), although there is no published literature on the rate of success after surgical correction in this cohort. Studies conducted on the general population show that 56.4% of esotropic patients have successful outcomes (no residual esotropia), with 86% cosmetic success rate. 54.9% of exotropic patients have successful outcomes (no residual exotropia), with a 94% cosmetic success rate (Abbasoglu, Sener, & Sanac, 1996).

#### 4.4.1 | Reoperation

Five patients (23.8%) reported requiring reoperations (one of these patients reported requiring repeat surgery but had not yet undergone the second procedure, while the other four had already undergone repeat surgeries). In the general population, about 8.1% of patients undergo additional operations (Leffler et al., 2015).

#### 4.4.2 | Lack of binocularity

One patient (4.8%) reported continued lack of binocularity after surgery (although patient reported around 30% of binocularity was regained through vision therapy).

#### 4.4.3 | Diplopia

One patient (4.8%) reported that their "eyes didn't align that much better than expected" and they continued to have issues with "peripheral double vision" which they also experienced before surgery. Double vision immediately following eye surgery is not uncommon, with up to 34% of patients experiencing temporary diplopia. Persistent diplopia is less common, occurring in 0.8%–14.0% of patients (Mills, Coats, Donahue, & Wheeler, 2004). Further information from the patient is recommended.

#### 4.4.4 | Amblyopia

One (4.8%) patient reported amblyopia, describing different degrees of vision in each eye. It is unclear whether the amblyopia developed after strabismus surgery or if strabismus developed from an underlying condition of amblyopia.

#### 4.4.5 | Overcorrection

One (4.8%) patient reported overcorrection. In adults, strabismus surgery has about an 87% success rate with "excellent" ocular alignment (Kushner, 2011). In children, strabismus surgery has a success rate of about 74% (Archer, Musch, Wren, Guire, & Del Monte, 2005).

### 4.5 | Oculoplastic surgeries

Thirteen patients underwent oculoplastic surgeries, out of which 5 (39%) reported surgical complications (although we deemed two complications as not true complications, bringing the percentage down to 23%). Oculoplastic surgery has been shown to have a 57% success rate as measured by objective means (by the surgeon), with 97% of patients judging themselves to have significant improvement (Scoppettuolo, Chadha, Bunce, Olver, & Wright, 2008).

Two patients reported requiring repeat ptosis, which is most likely connected to floppy eyelid. With floppy eyelid, the lids are horizontally unstable and there is a higher tendency for entropion and ectropion with age. Thus, there is difficulty in correcting eyelid involutional problems due to of multivector laxity (Damasceno, Osaki, Dantas, & Belfort, 2011; Joseph, Joseph, Francomano, & Kontis, 2018).

One patient reported that their "plugs began scratch [the patient's] eyes" for a punctal plug. About 20%–25% of patients experience complications after punctal plug insertion, with the known complications including "scratching and discomfort" (Murube, 2003).

Two patients reported complications that are not considered true complications of surgery. One reported floppy eyelid following optic nerve sheath fenestration. Floppy eyelid complicates surgery, but is not a complication of surgery (as discussed above in the paragraph on repeat ptosis, a true complication arising from floppy eyelid). The other patient reported a headache following surgery due to head positioning and a separate diagnosis of Chiari Malformation, which we did not include as a surgical complication.

### 4.6 | Cornea surgeries

Five patients underwent cornea surgeries (including corneal transplants, an iris lens clip, and two unspecified corneal surgeries), out of which three (60.0%) reported surgical complications. Corneal transplants have a graft survival rate of 91% at 1 year, 72% at 5 years, and 69% at 7 years, with about 80% of patients achieving at least one line of better acuity on the Snellen chart after their operation (Williams, Muehlberg, Lewis, & Coster, 1995). Complications typically include rejection, infection, or glaucoma (Williams et al., 1995).

One subject who reported the surgical complication described it as "a blood dot that kept growing;" it is possible this is referring to hyphema. While there have been a few case studies describing hyphema as a possible complication of eye surgery (in this case study, cataract rather than corneal surgery) (Krauthammer, Mandelblum, & Spierer, 2018), it typically results from blunt trauma to the eye, and corneal surgery can be used to correct it. It is possible that hyphema was a factor that complicated the surgery rather than a complication of the surgery. Overall, we found this response to be unclear and therefore did not categorize it as a complication.

One patient underwent surgery after an accident, specifically describing a surgery to "put [their] flap back into place." The patient reported a complication and a second surgery to remove "tiny plastic splinters from [an] accident [that] stayed behind between [the patient's] cornea and flap." This was not included as a true complication, as it was not a result of the surgery itself.

Another patient mentioned "difficulties suturing the cornea of the second eye" for an iris clip lens. Again, although this may have complicated the surgery, it was not a complication of the surgery.

As all reported complications were not true complications, this left a complication rate of 0.0%.

### 4.7 | Laser surgery for glaucoma

Four patients underwent laser surgeries for glaucoma, of which two (50%) reported surgical complications. One patient reported slow recovery time, not analyzed further here due to vagueness and one patient did not specify the complication. General success rates after laser surgery for glaucoma were around 68% 1-year postselective laser trabeculoplasty (SLT) surgery, and around 54% 1-year post-argon laser trabeculoplasty (ALT) surgery (Juzych et al., 2004).

## 5 | SUMMARY

Overall, EDS patients experienced complications already known and documented in the general population. However, our population did seem to experience unusually high complication rates compared to the general populations. It is important to note that we cannot ascribe the higher complication rate to the patients' underlying EDS; we clearly did not have enough data nor specific patient information for further analysis of the statistical significance of the disparities in complication rate. This is partially due to the fact that EDS is an uncommon and underdiagnosed disease (Castori, 2012), with little published on complications related to ophthalmic surgery. It is also possible there was selection bias in the administration of the survey, and patients who experienced surgical complications were more likely to respond to the survey than patients who underwent successful surgeries. Ultimately, we believe it is fair to suggest that it would be rationale to explore further whether EDS may be associated with a higher rate of complications after ocular surgery.

Our study revealed that many (76.4%) of the patients in the analyzed surgical categories (refractive, strabismus, cataract/lens, retina, oculoplastics, cornea, and laser surgery for glaucoma) underwent surgery ***before*** receiving their EDS diagnosis. This may be because patients do not learn of their diagnosis early in their life. This is particularly concerning because EDS is an absolute contraindication to LASIK according to the FDA. Considering EDS may put patients at higher risk for surgical complications, it would seem reasonable for physicians to explore in the preoperative period whether patients might have EDS. Simple screenings such as the Beighton Score and symptom questionnaires are readily available online (link: https://www.ehlers-danlos.com/ehlers-danlos-info/) and may enhance the ability of the surgeon to provide more thorough informed consent and help the patients have more realistic expectations of outcomes.

There were other important limitations to our study that must be acknowledged. First, we did not ask patients for documentation from their geneticists confirming their diagnoses. Furthermore, we did not test patients in any way to confirm their reported diagnosis. As with any survey, it may be that some respondents did not answer correctly and that could certainly affect the data. Another limitation of the dataset concerns the level of granularity provided in the survey, particularly concerning patient complications. It was clear that some of the patient-perceived complications were not likely to be considered as true complications by clinicians unless they persisted over a long period of time (e.g., wound leaks, postoperative pain). This study is a first step in understanding the landscape of ocular surgical complications faced by patients with EDS. Future studies are planned for this cohort, including offering ophthalmic evaluations to gain greater understanding of their surgical outcomes.

## CONFLICT OF INTEREST

The authors report no conflict of interest.

## ETHICAL COMPLIANCE

This study was approved by the Johns Hopkins Institutional Review Board, under IRB00164401.

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