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TITLE: Outcome of phacoemulsification in 71 cats: A multicenter retrospective study (2006-2017)

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JOURNAL: VETERINARY OPHTHALMOLOGY

PUBLISHER: Wiley

PUBLICATION DATE: 22 July 2019

DOI: <https://doi.org/10.1111/vop.12699>

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3 1 OUTCOME OF PHACOEMULSIFICATION IN 71 CATS: A MULTICENTER
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5 2 RETROSPECTIVE STUDY (2006-2017)
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50
51 22 **Purpose:** To assess outcome of phacoemulsification in cats. **Methods:** Records of 71
52
53 23 cats (82 eyes) from five referral centers were reviewed. Groups were divided by cause
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55 24 of cataract (congenital/juvenile (n=32), traumatic (n=33) and secondary to uveitis
56
57 25 (n=6)) and group comparisons were performed for the most common complications:
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3 26 postoperative ocular hypertension (POH), uveitis, corneal ulceration, synechia/dyscoria
4
5 27 and posterior capsular opacity (PCO) in three different time periods: immediately
6
7 28 postoperatively, at 1-90 days and at >90 days. **Results:** Median follow-up was 198 days
8
9 29 (interquartile-range 64-518 days). The overall visual success rate of the cats with a 12-
10
11 30 month follow up was 92.6% (25/27 eyes). POH occurred in 35/82 (42.6%) eyes.
12
13 31 Immediately postoperatively, uveitis was the most common complication in 28/82 eyes
14
15 32 (34.1%) followed by corneal ulceration in 22/82 eyes (26.8%). At 1-90 days, uveitis in
16
17 33 41/81 eyes (50.6%) remained the most common complication, followed by
18
19 34 synechia/dyscoria in 21/81 eyes (25.9%), corneal ulceration in 16/81 eyes (19.7%) and
20
21 35 PCO in 15/81 eyes (18.5%). At >90 days, PCO in 17/47 eyes (36.1%), followed by
22
23 36 synechia/dyscoria in 16/47 eyes (34%), were the most common complications. The
24
25 37 number of eyes with synechia/dyscoria in the trauma group was higher (13/33 (39.3%))
26
27 38 than in the congenital/juvenile group (5/31 (16.1%)) at 1-90 days (P=0.039). No
28
29 39 statistical difference was found for the other group comparisons. Three eyes in total
30
31 40 were enucleated owing to endophthalmitis, post-traumatic ocular sarcoma, and
32
33 41 secondary glaucoma. **Conclusion:** Uveitis in the short-term and PCO and
34
35 42 synechia/dyscoria in the long-term were the most common complications following
36
37 43 phacoemulsification in cats.
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45 **Key words:** phacoemulsification, cats, cataract, carbachol, sarcoma, trauma, uveitis

47 **Introduction**

48 Very few reports on cataracts in cats are available in the peer-reviewed literature. The
49 frequency of cataracts in cats has been reported to increase with age¹ and increased
50 numbers of cataracts have been reported in cats with diabetes and previous

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2
3 51 dehydrational episodes.¹ While primary and inherited cataracts are suspected to be rare
4
5 52 in cats, cataracts secondary to uveitis or trauma are thought to occur more commonly.²
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8 53 Primary cataracts have been documented in various feline breeds including Persian³,
9
10 54 Himalayan⁴, Russian blue⁵, British shorthair⁶ and Birman.⁷ Congenital cataracts in cats
11
12 55 have also been described as a manifestation of the Chediak-Higashi syndrome.⁸ A recent
13
14 56 publication describes cataracts suspected to have a hereditary component in a
15
16
17 57 population of Bengal cats in France.⁹
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21
22 59 The complications and visual outcome following phacoemulsification have been
23
24 60 reported in dogs and horses. In dogs, reported success rates are from 65-90% over
25
26 61 varying time periods: 90% and 65% at 12 and 24 months respectively,¹⁰ and 82.7% and
27
28 62 79% at a median of 10 and 28 months respectively.^{11,12} In horses, reported success rates
29
30 63 vary from 35-81%: 81% at a median of 28 days,¹³ 50% and 35% between one month to
31
32 64 six months and between six to 12 months respectively^{14,15} and 54% at a mean 35
33
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35 65 months postoperatively.¹⁴
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39
40 67 *Braus et al* evaluated the outcome of surgical treatment of lens laceration in six cats and
41
42 68 noted that all had a favorable outcome following surgery, with all patients being visual
43
44 69 at the last checkup and with only one patient showing a persistent posterior synechia as
45
46 70 minor complication.¹⁶ To the best of the authors' knowledge no other literature was
47
48
49 71 available on the outcome of lens surgery in cats apart from the paper by *Braus et al*. The
50
51 72 purpose of this study was therefore to assess the clinical findings, complications and
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53 73 visual outcome of a group of cats following phacoemulsification.
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58 75 **Materials and methods**
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3 76 Medical records of cats that underwent phacoemulsification from 2006 to 2017 in five
4
5 77 referral centers in the UK were reviewed. Ethical approval from the Animal Health
6
7 78 Trust (AHT, Newmarket, UK; 25-2017E) ethical committee was obtained. Data
8
9 79 collected included breed, sex, age, artificial intraocular lens implantation, cataract stage
10
11 80 (incipient, immature, mature, hypermature), suspected cause of the cataract
12
13 81 (congenital/hereditary, traumatic or secondary to uveitis), pre and postoperative
14
15 82 treatment, postoperative complications, visual outcome, use of intracameral carbachol
16
17 83 and postoperative mydriatics.
18
19 84 A successful outcome was defined as a visual and comfortable eye. Vision was based on
20
21 85 a positive menace response and, in cases of bilateral surgery, functional vision
22
23 86 according to the owner. For the purpose of this retrospective study, uveitis was
24
25 87 identified when there was aqueous flare, keratic precipitates and/or iris hyperemia as
26
27 88 these were the more common reported findings. In addition and for the purposes of this
28
29 89 study, postoperative ocular hypertension (POH) was considered when there was a
30
31 90 transient elevation in IOP (>25 mmHg) that resolved within 12–24 hours.¹⁷ The cases
32
33 91 that received intraocular pressure (IOP) regulating medication are specified.

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40 92 *1. – Pre-surgical assessment and treatment*

41
42 93 All cases underwent a full ophthalmic examination including slit lamp biomicroscopy,
43
44 94 indirect ophthalmoscopy and tonometry (Tonovet®, setting d, Icare, Finland). This was
45
46 95 performed by an ECVO diplomate, by an ECVO resident under direct supervision of a
47
48 96 diplomate or by an RCVS Ophthalmology Certificate holder. When available, an ocular
49
50 97 ultrasound was performed using topical proxymethacaine hydrochloride 0.5%
51
52 98 (Minims®, Bausch and Lomb, Surrey, UK) and a 10 to 18 mHz probe placed directly
53
54 99 on the cornea with coupling gel (Healthlife®, Barclay-Swann Ltd, Linconshire, UK). A
55
56 100 photopic and scotopic ERG (HM sERG 2000®, Ocuscience, Henderson, NV, USA);
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3 101 Eickemeyer®, Germany and RETIcom Flash®, Roland-Consult, Brandenburg,
4
5 102 Germany) was performed, in some cases under general anesthesia or sedation.
6
7 103 Preoperative treatment varied among centers and included topical flurbiprofen sodium
8
9 104 0.03% (Ocufen®, Allergan, Bucks, UK) 1 drop every 15 minutes for four hours,
10
11 105 phenylephrine 2.5% (Minims®, Bausch and Lomb, Surrey, UK) 1 drop/hour two doses
12
13 106 in total, tropicamide 0.5% (Minims®, Bausch and Lomb, Surrey, UK) 1 drop/hour two
14
15 107 doses in total, prednisolone acetate 1% (Pred Forte®, Allergan Ltd, Marlow, Bucks,
16
17 108 UK) 1 drop/hour four doses in total and atropine (Minims®, Bausch and Lomb, Surrey,
18
19 109 UK) to effect. Meloxicam 0.2mg/kg/subcutaneous (Metacam® 1.5 mg/ml, Boehringer
20
21 110 Ingelheim, Germany) was given routinely peri- or intra-operatively. Intravenous
22
23 111 cefuroxime 20 mg/kg (Zinacef®, Glaxo Operations UK Ltd, Middlesex, UK) was given
24
25 112 intraoperatively in some cases.

30 113 *2. - Surgery method and post-surgical treatment*

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32
33 114 During anesthesia a neuromuscular block was achieved with atracurium besylate
34
35 115 (Tracrium®, Aspen Pharma Trading Limited, Ireland) (0.1-0.3 mg/kg intravenously
36
37 116 initial dose). This was followed by another dose of 0.025-0.15 mg/kg intravenously
38
39 117 when deemed necessary by the anesthetist. Reversal was achieved with neostigmine
40
41 118 methylsulfate (Neostigmine®, Hameln Pharmaceuticals Ltd, UK) 40-50 mcg/kg slowly
42
43 119 intravenously when necessary. The surgical treatment included routine
44
45 120 phacoemulsification lens extraction (Oertli Faros 3000®, Oertli instruments,
46
47 121 Switzerland; Oertli OS3®, Oertli instruments, Switzerland; AMO Sovereign®, AMO
48
49 122 Signature®, Abbott Medical Optics, Santa Ana, California; now Johnson & Johnson as
50
51 123 of 2017), with or without placement of an artificial intraocular lens (IOL). The cornea
52
53 124 was incised and a 2-step or 3-step corneal wound was constructed. Intra-cameral
54
55 125 adrenaline (Dilute Adrenaline 1:10,000, Martindale pharmaceuticals, Essex, UK) 0.2ml
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3 126 was injected in the cases where topical mydriatics had not been given pre-operatively.
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5 127 The eye was inflated with a viscoelastic device (2% hydroxypropylmethylcellulose –
6
7 128 HPMC; An-Viscose® 2%, Visionary Surgical Solutions, Chesterfield, UK- and 1.4% or
8
9 129 2% sodium hyaluronate –AJL Ophthalmic SA, Spain-) according to surgeon's
10
11 130 preference. A side port was created when needed whilst using continuous irrigation. A
12
13 131 continuous anterior curvilinear capsulorrhexis was performed whenever possible
14
15 132 followed by phacoemulsification of the lens. Placement of an artificial intraocular lens
16
17 133 was performed when the integrity of the lens capsule allowed it. Intracameral carbachol
18
19 134 (Omnichol® 0.01%, Dioptrix, France) 0.2-0.4 ml was in some cases used at the end of
20
21 135 the surgery according to surgeon's preference. Postoperative IOP monitoring was
22
23 136 performed when patient cooperation allowed it and it varied between centers. When
24
25 137 POH occurred, additional measurements were taken as decided by the surgeon.
26
27 138 Postoperative treatment differed amongst centers and included topical and systemic
28
29 139 anti-inflammatories, topical and systemic antibiotics, mydriatic/cyclopegics and IOP
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31 140 regulating medication.
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37 141 3. - *Statistical analysis*

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39 142 Statistical analysis was performed using SPSS software (SPSS 21). The level of
40
41 143 significance was set at $p < 0.05$ for all analyses. Gaussian distribution was assessed
42
43 144 graphically and then with the Shapiro-Wilk test. Baseline descriptive statistics were
44
45 145 calculated and reported as percentages for categorical data and median and interquartile
46
47 146 range for continuous data.
48
49 147 Group comparisons were performed by chi-square or Fisher's exact test to compare
50
51 148 proportions as indicated; no attempt was made to correct for multiple comparisons.
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53 149 Group comparison when groups were divided by cause of cataract were performed for
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55 150 the most common complication variables: POH, uveitis, corneal ulcer,
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3 151 synechia/dyscoria, posterior capsular opacity (PCO) and glaucoma. Comparisons
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5 152 between the ability to implant an IOL in each group, carbachol and the presence of
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7 153 uveitis/fibrin in the immediately postoperatively period, and POH and the use of
8
9 154 carbachol, breed and IOL implantation were also performed. For this purpose, breeds
10
11 155 were grouped into pure breeds and non-pure breeds to minimize group numbers.
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13
14 156 Comparisons between the stage of cataracts and visual outcome were initially planned
15
16 157 during the study design. However, as the number of blind eyes was so low comparisons
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18 158 could not be carried out. All cases lost to follow up were excluded from statistical
19
20 159 analysis.
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25 26 161 **Results**

27
28 162 A total of 71 cats and 82 eyes were included in the study with 11 cats undergoing
29
30 163 bilateral surgery. Three cats with bilateral cataract had each eye operated during
31
32 164 separate procedures. The cause of the cataract was suspected to be congenital/juvenile
33
34 165 in 32/82 (30%), traumatic in 33/82 (40.2%), secondary to uveitis in 6/82 (7.3%), and it
35
36 166 was not known in 11/82 (13.4%) cases. Regarding the stage of the cataract, there were
37
38 167 27/82 (32.9%) incipient, 28/82 (34.1%) immature, 20/82 (24.4%) mature, 2/82 (2.4%)
39
40 168 hypermature, and in 5/82 (6%) the stage was not described on the records. Sex included
41
42 169 6 male entire, 34 male neutered and 31 female neutered cats. Population age was 37
43
44 170 months (interquartile range (IQR) 12-72 months). There were 45 Domestic short hair
45
46 171 (DSH), 5 Domestic long hair (DLH), 6 British short hair (BSH), 3 Persian, 2 Persian
47
48 172 crosses, 2 Savannah, 2 Birman and one each of: Siberian, Ocicat, Bengal, Abyssinian,
49
50 173 Foreign shorthair and Maine Coon. An ocular ultrasound was performed in 56/82
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52 174 (68.3%) eyes and an ERG in 9/82 (11%) eyes. The ERG was normal in all cases.
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58 175 *Overall results*
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3 176 Cases were followed for 198 days (IQR 64-518 days; range 6-1899 days). The overall
4
5 177 success rate of the cats that remained within the study with a 12-month follow up was
6
7 178 92.6% (25/27). A total of 89.5% (43/48) eyes were visual at the last follow up with 34
8
9
10 179 eyes lost to follow up. Three eyes in total were enucleated: two in the trauma group
11
12 180 owing to endophthalmitis (17 days postoperatively) and post-traumatic ocular sarcoma
13
14 181 (640 days postoperatively) respectively and one in the uveitis group due to secondary
15
16 182 glaucoma (1335 days postoperatively). Two of the eyes (2/27; 7.4%) that remained
17
18 183 within the study with a 12-month follow up were blind. One of them was reported non-
19
20 184 visual but no reason was given and the other one had retinal degeneration of unknown
21
22
23 185 origin.
24
25 186 An IOL was implanted in 58/82 (70.7%) eyes. POH occurred in 35/82 (42.6%) eyes.
26
27 187 Intracameral carbachol was used in 38/82 (46.3%) eyes. Immediately postoperatively,
28
29 188 82/82 (100%) eyes were visual. Uveitis 28/82 (34.1%) was the most common
30
31 189 complication followed by corneal ulceration 22/82 (26.8%) immediately
32
33 190 postoperatively. At 1-90 days postoperatively 30/31 (96.7%) eyes with
34
35 191 congenital/juvenile, 30/33 (90.9%) traumatic and 6/6 (100%) secondary to uveitis
36
37 192 cataracts were visual. Uveitis 41/81 (50.6%) remained the most common complication
38
39 193 followed by synechia/dyscoria 21/81 (25.9%), corneal ulceration 16/81 (19.7%), and
40
41 194 PCO 15/81 (18.5%). More than 90 days postoperatively, 19/19 (100%) eyes with
42
43 195 congenital/juvenile, 15/17 (88.2%) traumatic and 3/4 (75%) secondary to uveitis were
44
45 196 visual. PCO 17/48 (35.4%) followed by synechia/dyscoria 16/48 (33.3%) were the most
46
47 197 common complications (Table 1).
48
49 198
50
51 199 The prevalence of POH was significantly lower in cases in which intracameral
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53 200 carbachol was used (P=0.026). The number of eyes with synechia/dyscoria in the
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3 201 trauma group was higher (13/33 (39.3%)) than in the congenital/juvenile group (5/31
4
5 202 (16.1%)) at 1-90 days (P=0.039). There were no statistical differences among the
6
7 203 groups for the rest of the group comparisons that were assessed. Mydriatics were used
8
9 204 in 15/82 (18.3%) cases. There was no uniformity in their use; in some cases it was
10
11 205 based solely upon the presence of synechia/dyscoria and in other cases these were used
12
13 206 immediately after surgery. Comparisons between the use of mydriatics and the presence
14
15 207 of synechia/dyscoria in each group could not, therefore, be carried out.

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19 208 *1. - Congenital/juvenile*

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21 209 Twenty-three cats (31 eyes) had congenital/juvenile cataracts (14 unilateral and 9
22
23 210 bilateral). The stage of the cataract was classified as incipient in 2/32 (6.2%) cases,
24
25 211 immature in 20/32 (62.5%) and mature in 10/32 (31.2%). There were 17 (53.1%) male
26
27 212 neutered, 9 (28.1%) female neutered and 6 (18.7%) male entire cats. Population age was
28
29 213 24 months (IQR 7-47 months). Breeds included 8 DSH, 3 BSH and one each of DLH,
30
31 214 Foreign shorthair, Maine Coon, Birman, Bengal, Ocicat, Persian, Persian cross and
32
33 215 Savannah. POH occurred in 14/32 eyes (43.7%) and an IOL was implanted in 29/32
34
35 216 eyes (90.6%). One of the cats had dendritic corneal ulceration in the immediate
36
37 217 postoperative period and received a two-week course of ganciclovir 0.15% (Virgan®,
38
39 218 Laboratoires Thea, France) five times daily. No testing for feline herpesvirus-1 was
40
41 219 performed. One of the cases had pre-existing bilateral lens capsule rupture and lens
42
43 220 material in the vitreal cavity; bilateral core vitrectomy was performed at the time of
44
45 221 surgery.
46
47 222 At 1-90 days after surgery 30/31 (96.7%) eyes were visual; one was blind and one was
48
49 223 lost to follow up. The cause of the blindness was suspected retinal degeneration
50
51 224 following POH. Thirteen cases were lost to follow up more than 90 days
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3 225 postoperatively, including the blind eye with suspected retinal degeneration following
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5 226 POH. The remaining 19 eyes (100%) were visual.
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8 227 *2. - Traumatic*
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10 228 Thirty-three cats (33 eyes) suffered a traumatic injury to the lens. The stage of the
11
12 229 cataract was classified as incipient in 25/33 (75.7%) cases, immature in 2/33 (6%),
13
14 230 mature in 2/33 (6%) and in 4/33 (12.1%) cases it was not recorded. There were 15
15
16 231 (45.4%) male neutered, 16 (48.4%) female neutered and 2 (6%) entire male cats.
17
18 232 Population age was 30 months (IQR 13-70 months). Breeds included 24 DSH, 2 BSH, 2
19
20 233 DLH and one each of Persian, Persian cross, Savannah, Siberian and Abyssinian. POH
21
22 234 occurred in 10/33 eyes (30.3%) and an IOL was implanted in 16/33 eyes (48.5%). Three
23
24 235 cases in this group were hospitalized and treated medically before surgery. Following
25
26 236 surgery, three cases received a conjunctival pedicle graft over a corneal laceration and
27
28 237 another case underwent a corneal autograph transplant and core vitrectomy. Another
29
30 238 case was admitted for a vitrectomy twenty days after phacoemulsification; a thorn had
31
32 239 been removed from the eye at the time of surgery but no information was available
33
34 240 within records as to why vitrectomy was required. A cat with a partial retinal
35
36 241 detachment identified in the immediate postoperatively period underwent a barrier
37
38 242 retinopexy. The detachment was no longer visualized at the next examination. At 1-90
39
40 243 days post surgery 30/33 (90.9%) eyes were visual and one eye was enucleated due to
41
42 244 endophthalmitis. No information was available as to the cause of the blindness in one
43
44 245 case. The remaining blind eye had retinal degeneration of unknown origin. In this cat,
45
46 246 examination of the fundus immediately after surgery was normal. At the last
47
48 247 examination 16 eyes were lost to follow up. Two eyes were blind: the one with retinal
49
50 248 degeneration and one that was enucleated and diagnosed with post-traumatic sarcoma.
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52 249 The remaining eyes were visual (15/17; 88.2%).
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3 250 3. - *Secondary to uveitis*
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5 251 Four cats (6 eyes; 2 unilateral and 2 bilateral) had cataracts secondary to uveitis. The
6
7 252 stage of the cataracts was classified as immature, mature and hypermature in 2 (33.3%)
8
9 253 cases each. There were 3 (75%) male neutered and 1 (25%) female neutered cats and
10
11 254 population age was 91 months (IQR 62-120 months). They were all DSH. Three cats
12
13 255 underwent further investigation: hematology (n=3) and biochemistry (n=3), feline
14
15 256 leukemia virus (n=2), feline immunodeficiency virus (n=2), *Toxoplasma* IgG/IgM (n=2)
16
17 257 and Coronavirus titers (n=1). One case showed evidence of exposure to *Toxoplasma*
18
19 258 *gondii* (IgG=1:1024), lymphopenia ($0.67 \times 10^9/L$ (1.50-7)), thrombocytopenia
20
21 259 ($112 \times 10^9/L$ (300-700)), increased amylase (1434 iU/L (400-1400)) and creatine kinase
22
23 260 (552 iU/L (70-190)) and mild proteinemia 78g/L (55-75)). One of the cases declined
24
25 261 further investigation and underwent phacoemulsification without a diagnostic work-up.
26
27 262 The rest of the results were unremarkable. POH occurred in 3/6 eyes (50%) and an IOL
28
29 263 was implanted in 5/6 eyes (83.3%).
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35 264 At 1-90 days postoperatively 6/6 (100%) were visual. At more than 90 days
36
37 265 postoperatively, one eye was lost to follow up and one was enucleated due to secondary
38
39 266 glaucoma (no histology was performed). This cat had not been receiving glaucoma
40
41 267 regulating medication prior to enucleation. The remaining eye of this cat appeared to
42
43 268 have developed secondary glaucoma as per the clinical information provided by the
44
45 269 referring veterinarian and was euthanized one year after enucleation of the first eye. No
46
47 270 histology or necropsy examination were performed. Of the remaining eyes 3/4 (75%)
48
49 271 eyes were still visual.
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51
52

53 272 4. - *Unknown cause*
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55 273 In eleven cases, the cause of the cataract was not reported/known; all of them had a
56
57 274 unilateral cataract. The stage of the cataract was classified as immature in 4/11 (36.3%)
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3 275 cases and mature in 6/11 (54.5%) cases; one case the stage was unknown. There were 1
4
5 276 (9%) male entire, 4 male neutered (36.3%) and 6 (54.4%) female neutered cats.
6
7 277 Population age was 84 months (IQR 43-108 months). Breeds included 7 DSH, 2 DLH
8
9 278 and one each of Persian and Birman. All cases were visual immediately after surgery.
10
11 279 At 1-90 days postoperatively 10/11 (90.9%) were visual. The cause for the blind eye
12
13 280 was not reported in the records. More than 90 days postoperatively, 6/7 (85.7%) eyes
14
15 281 were visual and four eyes were lost to follow up.
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283 **Discussion**

284 The outcome of phacoemulsification in cats is rarely reported in the literature. *Stiles*
285 (2013) reported that the success rate for cataract surgery in cats appears better than in
286 dogs.² *Braus et al (2015)* concluded that overall, cats appeared to develop less
287 inflammation following lens trauma and lens surgery than did dogs.¹⁶ The results of our
288 retrospective study show an overall success rate of 92.6% for cats that remained within
289 the study with a 12-month follow-up, and 89.5% still visual at the last follow-up (range
290 6-1898d). POH (42.6%) was the most common complication in the immediate
291 postoperative period. Reports of POH in dogs vary between 37.5%–48.9% (17,18),
292 which is comparable to our findings. Another report found that POH in dogs occurred in
293 22.9% of eyes.¹² The use of carbachol was suggested to be the factor contributing to a
294 lower POH prevalence in that study.¹² Overall, the use of carbachol to reduce POH after
295 phacoemulsification in dogs has shown conflicting results in the literature, and its effect
296 is not clear.^{19,20} The use of carbachol and its effect in diminishing the development of
297 POH in our study was statistically significant. However, the results may have been
298 influenced by the multi-centered nature of the study and the different surgical
299 approaches used by individual surgeons. A prospective study with standardized
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3 300 variables would be required to confirm this finding. Carbachol is thought to prevent or
4
5 301 attenuate POH by opening the ciliary cleft, which has been experimentally
6
7 302 demonstrated to be collapsed for at least 24 hours following phacoemulsification in
8
9 303 dogs.²¹ However, *Crasta et al (2010)* found that the use of carbachol did not prevent
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11 304 POH in dogs and concluded that this variable effect may be due to the fact that ciliary
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13 305 cleft collapse alone is not responsible for POH.¹⁹ Labradors have been reported to
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15 306 experience a significantly increased risk of POH when compared to other breeds.²² No
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17 307 breed association was evident in our study, however it may have been significant with a
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19 308 larger number of cases.
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23 309 Uveitis (50.6%) was one of the most common complications in the 1-90 day
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25 310 postoperative period. Uveitis would have been expected in every case following
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27 311 surgery, as a breakdown of the blood aqueous barrier occurs following
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29 312 phacoemulsification.²³ The reduced percentage of cases experiencing uveitis is likely
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31 313 due to the lack of information registered in the medical records, as it is likely that only
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33 314 “unusual” complications were recorded. Despite this, we included uveitis as a
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35 315 postoperative complication as it was obvious that there is a marked reduction in its
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37 316 occurrence more than ninety days postoperatively. Synechia/dyscoria (25.9%) was
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39 317 another complication at 1-90 days postoperatively, the occurrence was statistically
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41 318 significant between the congenital/juvenile (16.1%) and trauma (39.3%) groups, being
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43 319 higher in the trauma group. This result correlates with the expected clinical findings, as
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45 320 a damaged iris following trauma and the resultant uveitis/iritis are a common finding in
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47 321 these cases. PCO (36.1%) was the most common complication in the more than 90 days
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49 322 postoperative period. Some studies in dogs have reported PCO as the most common
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51 323 complication after cataract surgery.^{24,25} In our study, PCO was the most common long-
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53 324 term complication, affecting more than one third cases. The identification and
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3 325 characterization of PCO has limitations; a grading system would have been needed to
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5 326 assess the degree of opacity and the apparent impact on vision.
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7 327 Corneal ulcers are not a reportedly common complication following cataract surgery in
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9 328 dogs.^{11,24} In our study, corneal ulceration was reported in 26.8% of cats in the
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11 329 immediate postoperative period. The prevalence of corneal ulceration decreased to
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13 330 19.7% in the 1-90 days postoperatively period, and to 12.7% in the more than 90 days
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15 331 period. The corneal ulcers present in these cases were not sufficiently described on the
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17 332 clinical records to draw any conclusion about the possible cause. Exposure related
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19 333 ulceration during or following surgery is most likely in the immediate post-operative
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21 334 period but a stress induced herpetic flare up cannot be excluded. Topical prednisolone
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23 335 was discontinued and non-steroidal anti-inflammatories were used instead in those cases
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25 336 where corneal ulceration occurred.
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27 337 Glaucoma has been commonly reported as a complication in dogs following cataract
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29 338 surgery, with a prevalence that varies from 6.7% to 28.8%.^{9,24,26,27} The glaucomas are a
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31 339 diverse group of diseases united only by the fact that, at least initially, IOP is too high to
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33 340 permit the optic nerve and, in some species, the retina to function normally.²⁸
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35 341 Characteristic changes of glaucoma include disrupted axoplasmic flow in the optic
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37 342 nerve head, death of retinal ganglion cells and their axons, cupping of the optic disc,
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39 343 and visual impairment or blindness.²⁸ Glaucoma was not a common complication in our
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41 344 study. Of the three eyes that were enucleated in the total reviewed cases only one was
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43 345 enucleated owing to a diagnosis of secondary glaucoma 3.6 years after surgery (but no
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45 346 histology was performed). The referring veterinarian euthanized this same cat one year
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47 347 later because of suspected secondary glaucoma in the remaining eye. Only two eyes
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49 348 continued to receive IOP regulating medication at their last follow-up (2/47; 4.2%) but
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51 349 no vision loss was documented. The eyes that received IOP regulating medication
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3 350 during the 1-90 day postoperative period (47/80; 58.7%) did not continue to suffer from
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5 351 an elevated IOP, did not have any reported visual loss, and eventually were tapered off
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7 352 of the medication (apart from the two cases mentioned above). One of the other two
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9 353 enucleated eyes from the trauma group was histologically diagnosed with post-
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11 354 traumatic sarcoma at 620 days after phacoemulsification. Feline ocular sarcomas are
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13 355 malignant intraocular neoplasms that are often associated with a history of ocular
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15 356 trauma.^{29,30,31} In general, they are locally invasive, potentially metastasize, and usually
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17 357 necessitate enucleation of the affected eye.³² A report that looked at clinical and
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19 358 morphologic features of post-traumatic sarcoma in cats concluded that the most
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21 359 common consequence was infiltration of the optic nerve, which may extend to the optic
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23 360 chiasm and brain causing blindness and neurological disease.²⁹ In the cat reported here,
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25 361 the histology report concluded that it was a fairly early stage of the disease with no
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27 362 evidence of scleral or vascular invasion and no extension into the optic nerve. The cat
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29 363 was still alive 3 years after phacoemulsification and 1.3 years after enucleation.
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31 364 An IOL was implanted in a total of 70.7% eyes. There was a statistically significant
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33 365 difference between the congenital/juvenile and the trauma group, with the former
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35 366 having an implanted IOL in 90.6% of the cases compared to 48.5% in the trauma group.
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37 367 This is not surprising as trauma of the lens may create a capsular tear that precludes IOL
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39 368 implantation.
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41 369 The major limitations of the study are the ones related to its retrospective nature. The
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43 370 ocular findings considered for the diagnosis of uveitis were aqueous flare, keratic
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45 371 precipitates and/or iris hyperemia, as these were the more commonly reported findings
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47 372 in the cat's medical records. Therefore, the assessment of uveitis, both in a lower than
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49 373 expected number of cases as it is likely that only "unusual" complications were
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51 374 recorded and with only selected ocular clinical signs, is one of the limitations of this
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3 375 retrospective study. Another limitation is found in the secondary to uveitis cataract
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5 376 group. In these cases, the cause was already established in the medical records and we
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7 377 cannot rule out that these cats experienced primary cataract formation and lens-induced
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9 378 uveitis. The study involved five different referral centers with different surgeons and no
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11 379 standardization of the treatment protocols. Thirty-four cases were lost to follow up. The
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13 380 lost to follow up cases are inherent to the nature of a retrospective study and this
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15 381 decreases its power; clinically significant statistical differences (type II error) may have
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17 382 been observed in a larger population.
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19 383 In conclusion, this is the first retrospective study that has assessed the outcome of
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21 384 phacoemulsification in cats. The authors conclude that the prognosis for vision after
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23 385 surgery appears to be favorable, with serious complications such as intraocular sarcoma
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25 386 being rarely encountered.
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400 **Acknowledgement**

401 The authors would like to thank Domingo Casamian-Sorrosal for his invaluable help
402 with data analysis.

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Overall	Immediate	1-90 d	>90 d
Corneal ulcer	22/82 (26.8%)	16/81 (19.7%)	6/48 (12.5%)
Corneal edema	1/82 (1.2%)	2/81 (2.4%)	0/48 (0%)
Corneal lipidosis	0/82 (0%)	1/81 (1.2%)	1/48 (2%)
Suture breakdown	0/82 (0%)	1/81 (1.2%)	0/48 (0%)
Uveitis	28/82 (34.1%)	41/81 (50.6%)	10/48 (20.8%)
Hyphema	2/82 (2.4%)	0/81 (0%)	0/48 (0%)
Fibrin	8/82 (9.7%)	7/81 (8.6%)	0/48 (0%)
Synechia/Dyscoria*	3/82 (3.6%)	21/81 (25.9%)*	16/48 (33.3%)
PCO	0/82 (0%)	15/81 (18.5%)	17/48 (35.4%)
Haptic luxation	0/82 (0%)	1/81 (1.2%)	0/48 (0%)
POH	35/82 (42.6%)	0/81 (0%)	0/48 (0%)
Intraocular pressure regulating medication	0/82 (0%)	48/81 (59.2%)	2/48 (4.1%)
Vitreous opacity	0/82 (0%)	1/81 (1.2%)	0/48 (0%)
Subretinal oedema/ chorioretinitis	0/82 (0%)	0/81 (0%)	1/48 (2%)
Partial retinal detachment	1/82 (1.2%)	0/81 (0%)	0/48 (0%)
Retinal degeneration	0/82 (0%)	2/81 (2.4%)	1/48 (2%)
Photoreceptor lesion	0/82 (0%)	1/81 (1.2%)	0/48 (0%)

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3 **Table 1.** Overall complication rate in the three study time periods. * The number of
4 eyes with synechia/dyscoria in the trauma group was higher than in the
5 congenital/juvenile group at 1-90 days (P=0.039). There were no other statistically
6 significant differences between any time periods for the various complications.
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12 POH: postoperative ocular hypertension

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15 PCO: posterior capsular opacity
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