

# Glaucoma Care of Incarcerated Patients at an Academic Institution: A Case-Control Study

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## Abstract

**Purpose:** To evaluate medication and follow-up adherence in incarcerated patients examined at an academic glaucoma clinic, in comparison to nonincarcerated controls.

**Methods:** Retrospective, case-control study. Consecutive prisoners presenting for initial visits in the Glaucoma Clinic at the Illinois Eye and Ear Infirmary between December 2015 and December 2017 were included in the study. Nonincarcerated patients seen in the same Glaucoma Clinic with similar initial visit dates, age, race, sex, and disease severity were selected as controls. Glaucoma Clinic visits from each patient were reviewed until December 2018. Examination information, surgical intervention, follow-up and treatment recommendations, and patient-reported medication usage were recorded for each visit. Number of visits, loss to follow-up, follow-up delays, and medication nonadherence were studied as primary outcome measures.

**Results:** Twenty-four prisoners and 24 nonincarcerated controls were included. Prisoners had an average of  $2.46 \pm 2.38$  visits during the study period, compared to  $5.04 \pm 3.25$  for controls ( $P = 0.001$ ). Follow-up visits occurred more than 30 days after the recommended follow-up time in 57.4% (95% confidence interval [CI]: 44.2%–70.6%) of prisoners, compared to 17.9% (95% CI: 10.2%–25.6%) of controls ( $P < 0.00001$ ). 70.8% of prisoners (95% CI: 66.3–74.5%) were lost to follow-up, compared to 29.2% of controls (95% CI: 25.5%–32.9%;  $P < 0.01$ ). Medication nonadherence rates were similar between prisoners (13.6%; 95% CI: 12.1%–15.2%) and controls (12.0%; 95% CI: 11.4%–12.6%;  $P = 0.78$ ).

**Conclusions:** Glaucoma follow-up adherence was significantly worse in prisoners compared to a nonincarcerated control population. Further study into causative factors is needed.

**Keywords:** Adherence, Case-control study, Compliance, Follow-up, Glaucoma, Imprisoned, Jail, Prisoners

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## INTRODUCTION

Prisoners make up a significant and growing portion of the population in the United States, with over 2.2 million prisoners in 2016.<sup>1</sup> The medical care of incarcerated patients is different in many ways from the care of the general population. Constant structured supervision may portend increased medication adherence and follow-up; in contrast, prisoner status results in significant regulations on free movement

which may negatively impact medical care. Moreover, the demographic makeup of the prisoner population itself has healthcare implications as well: for example, up to two-thirds of inmates are drug-dependent or drug-abusing, compared to 5% of the general adult population;<sup>2</sup> approximately one-quarter of inmates have been diagnosed with a psychiatric condition;<sup>3</sup> and the proportion of elderly prisoners has been increasing over time.<sup>4</sup> Security measures mean that a typical outpatient visit with a prisoner is quite different from that of a

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nonincarcerated patient. For example, prisoners are typically seen in a separate examination room, with hands cuffed and security guards physically present. Surgical subspecialty care has the potential to be particularly impacted by the challenges of prisoner healthcare. Postoperative care often necessitates frequent follow-up, which may be difficult to arrange with correctional facilities. One review of orthopedic care of prisoners cited delay in, restrictions of, and limitations of care as three important factors impacting care of prisoners.<sup>5</sup>

Despite these challenges, the medical care of prisoners remains understudied. While barriers to care have been researched predominantly in the infectious disease<sup>6-8</sup> and psychiatry literature,<sup>3,9,10</sup> the ophthalmology literature is lacking in this regard. In a recently published study, our group has found substantial medication and follow-up nonadherence among prisoners with glaucoma.<sup>11</sup> Given the well-established importance of medication and follow-up adherence in the management of glaucoma,<sup>12,13</sup> and given the prevalence of adherence issues in the general glaucoma population, we sought to evaluate the significance of nonadherence among prisoners by comparing to a nonincarcerated control population.

## METHODS

All incarcerated patients seen for initial visits in the Glaucoma Clinic at the Illinois Eye and Ear Infirmary between December 2015 and December 2017 were included. For each prison inmate, nonincarcerated patients initially seen within 4 weeks of the prisoner's initial visit date were reviewed for inclusion as controls. Controls were selected with the same race, sex, and disease severity, and with an age that varied by at most 5 years from the given prison inmate. Cases and controls were treated by one of the various glaucoma specialists on staff in the clinic. Disease severity was assessed based on the American Academy of Ophthalmology Preferred Practice Pattern.<sup>14</sup> Given that follow-up adherence was a key aspect of this study, and the case group included prisoners with transportation to clinic visits and medical coverage provided by the State, controls with home addresses in close proximity to the clinic and with public insurances (Medicare and Medicaid) were preferred.

Cases and controls were followed until December 2018, providing at least 1 year and up to 3 years of follow-up. Demographic information such as age, sex, race, medical and ocular history, smoking, and alcohol consumption were recorded from the initial visit. A Charlson Comorbidity Index<sup>15</sup> was calculated for each patient. Each visit within the study period was reviewed for examination information, treatment recommendations, surgical interventions, and follow-up recommendations. Patient-reported adherence with medical therapy was recorded for each visit. Disease progression was not studied in either group as the follow-up period was short.

Continuous variables undergoing *t*-test analysis were confirmed to be normally distributed using the Shapiro–Wilk test. Statistical comparisons were made using Student's *t*-test, Mann–Whitney U test, analysis of variance, Chi-square test,

and Fisher's exact test, as appropriate. Statistical significance was set at  $P < 0.05$ . Statistical analysis was performed using R, version 3.5.3 (R Core Team).

The study followed the research agreement established by the Illinois Department of Corrections and received University of Illinois at Chicago Institutional Review Board approval. A waiver for patient informed consent was obtained for this retrospective study. The study was conducted according to the tenets of the Declaration of Helsinki and in compliance with the Health Insurance Portability and Accountability Act.

## RESULTS

Twenty-four prisoners had initial visits in the glaucoma clinic during the study period and 24 nonincarcerated patients were selected as controls. Baseline characteristics were similar between prisoners and controls [Table 1]. All patients were male. The majority of prisoners were black ( $n = 17$ , 70.8%), followed by white ( $n = 4$ , 16.7%), Hispanic ( $n = 2$ , 8.3%), and Asian ( $n = 1$ , 4.2%). Controls had a similar racial composition (Black or African American:  $n = 15$ , 62.5%; white:  $n = 5$ , 20.8%; Hispanic:  $n = 4$ , 16.7%). Mean Charlson Comorbidity Index was not significantly different between prisoners and controls ( $2.79 \pm 3.15$  vs.  $2.63 \pm 2.90$ ,  $P = 0.80$ ). Controls lived on an average  $12.7 \pm 16.9$  km from the glaucoma clinic. Eleven controls had public health insurance, while the remainder were under private insurance plans.

The majority of eyes in each group either had primary open-angle glaucoma (POAG) or was POAG suspects, with the two conditions together accounting for 73.2% of prisoners and 78.0% of controls. The nonincarcerated controls had initial visits that corresponded closely with the paired prisoner initial visit, with on average  $1.6 \pm 1.4$  months difference.

Prisoner follow-up characteristics differed significantly from those of nonincarcerated controls [Table 2]. On average, prisoners had fewer than half as many visits as controls over the study period. Total follow-up time was significantly lower for prisoners compared to controls, and a significantly higher number of prisoners were lost to follow-up before the end of the study period. Moreover, eleven prisoners had only one single visit in the glaucoma clinic and were lost to follow-up thereafter, compared to three nonincarcerated controls ( $P = 0.01$ ). Visual field testing was performed significantly more often in nonincarcerated patients compared to controls, while optical coherence tomography (OCT) testing was performed at a similar rate between the two groups [Table 2].

Timeliness of follow-up was significantly different between the study groups [Figure 1]. Only 9.2% (95% confidence interval [CI]: 1.5%–17.0%) of prisoner return visits occurred within the recommended follow-up time, compared to 44.2% (95% CI: 34.2%–54.2%,  $P < 0.00001$ ) of controls. Furthermore, only 42.6% of prisoner return visits (95% CI: 29.4%–55.8%) occurred within 1 month of the recommended follow-up time, compared to 82.1% of controls (95% CI: 74.4%–89.8%,  $P < 0.00001$ ).

**Table 1: Baseline patient characteristics of prisoners are controls**

	Prisoners (n=24), n (%)	Controls (n=24), n (%)	P
Sex: Male	100	100	
Age (mean±SD)	50.9±12.0	53.4±10.8	0.45
Race: Black	17 (70.8)	15 (62.5)	0.38
Charlson comorbidity index <sup>15</sup>	2.79±3.15	2.63±2.90	0.80
Primary diagnosis by eye			
POAG	15 (36.6)	11 (26.8)	
POAG suspect	15 (36.6)	21 (51.2)	
PACS	4 (9.8)	2 (4.9)	
Normal tension glaucoma	2 (4.9)	2 (4.9)	
Traumatic glaucoma*	3 (7.3)	4 (9.8)	
Uveitic glaucoma	2 (4.9)	1 (2.4)	
Glaucoma disease severity (maximum per patient) <sup>†</sup>			
Suspect	12	14	
Mild	2	0	
Moderate	5	2	
Advanced	5	8	

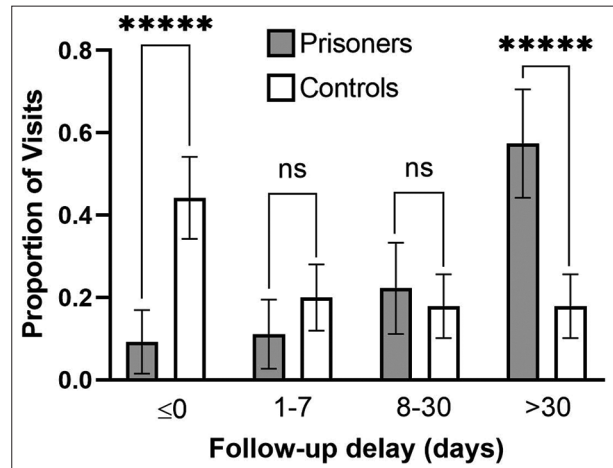
\*Includes angle recession glaucoma and traumatic glaucoma without angle recession, <sup>†</sup>In case of asymmetric disease severity, the eye at the most advanced stage was recorded. POAG: Primary open-angle glaucoma, PACS: Primary angle-closure suspect, SD: Standard deviation

**Table 2: Follow-up and clinical testing characteristics of patients**

	Mean±SD		P
	Prisoners (n=24)	Controls (n=24)	
Number of visits	2.46±2.38	5.04±3.25	0.001
Total follow-up time (days)	131.6±181.2	386.7±300.3	0.001
Loss to follow-up, n (%), 95% CI	17 (70.8), 66.3-74.5	7 (29.2), 25.5-32.9	<0.01
Ancillary testing*			
Visual field <sup>‡</sup>	1.04±0.69	1.83±1.27	0.02
OCT <sup>‡</sup>	0.46±0.51	0.50±0.66	0.99

\*Mean number of tests performed during the study period per patient, <sup>‡</sup>Humphrey or Goldmann visual field testing, <sup>‡</sup>OCT - retinal nerve fiber layer measurements. CI: Confidence interval, SD: Standard deviation, OCT: Optical coherence tomography

Management did not differ significantly between prisoners and controls. Number of topical ocular antihypertensive medications was similar among both groups (prisoners: 1.83 ± 1.58; controls: 1.58 ± 1.59; P = 0.62). Of those patients requiring medical therapy, nonadherence was frequent in both groups. At 13.6% (95% CI: 12.1%–15.2%) of prisoner visits and 12.0% (95% CI: 11.4%–12.6%) of control visits (P = 0.78) patients indicated some degree of nonadherence with medications. However, although not statistically significant, the visits with reported medication nonadherence were contributed by a fewer number of patients in the control group versus the prisoner group (21.0% vs. 40.0%, P = 0.28). In other words, approximately 80% of control patients reported medication adherence at every visit during the study period, compared to 60% of prisoners. Neither study group demonstrated a significant association between follow-up delay and medication nonadherence (prisoners: P = 0.46; controls: P = 0.76).



**Figure 1: Follow-up delay per visit.** Proportions of cumulative follow-up visits within specified delay ranges are displayed for prisoners and for controls. Error bars indicate 95% confidence interval. NS: Nonsignificant; \*\*\*\*\*P < 0.00001

Surgical interventions among the two groups included laser peripheral iridotomy, cyclophotocoagulation, laser trabeculoplasty, glaucoma drainage device, and cataract extraction. A similar number of surgical procedures were performed in the two groups (prisoners: 7; controls: 9; P = 0.54). However, only two incisional procedures (cataract extraction and glaucoma drainage implant) were performed in the control group, compared to no incisional procedures in the prisoner group. There were no surgical complications recorded for any patients during the study period. Neither per-patient average (prisoners: 15.6 ± 3.8; controls: 16.5 ± 6.7; P = 0.76) nor per-patient maximal (prisoners: 18.9 ± 7.3; controls: 23.1 ± 12.7; P = 0.60) intraocular pressure varied significantly between the two study populations.

## DISCUSSION

This study demonstrated the significant challenges that may exist in the clinical care of prisoners with glaucoma when compared to nonincarcerated patients. Issues with delays in follow-up and loss to follow-up were among the most prominent differences. The results of this study parallel the findings suggested in a recently-published descriptive study by our group.<sup>11</sup> With the addition of a control group, the significance of these findings with respect to the general, nonincarcerated glaucoma population could be established.

Follow-up control is a complex issue in the management of prisoners with glaucoma. At clinic visits, providers may be discouraged from disclosing follow-up information to the patient for security purposes. If follow-up recommendations are not communicated with the patient, the importance of timely follow-up may not be well-conveyed. While the prison theoretically provides transportation to follow-up visits, the attendance at a follow-up visit may be refused by the prison inmate. Establishing timely follow-up also presents logistical challenges. In our practice, follow-up recommendations are shared with the prison via a written report completed at the end of the examination. The follow-up visit is scheduled when this written report is reviewed by the facility and coordinated with the clinic. Thus, there is a delay and a higher level of complexity in establishing a follow-up visit for a prisoner when compared to a nonincarcerated patient. Prisons may limit the number of prisoners who may be out of the facility at a given time, and this may complicate the prison's ability to schedule follow-up visits. Finally, some incarcerated patients may have been released from prison during their follow-up period, accounting for some of the loss to follow-up. It is possible that these patients have found glaucoma care elsewhere after release, but it is also possible that no proper transition of care was established. Further study into these issues is important. Given the importance of follow-up adherence, especially in post-surgical patients, the root causes of delays in prisoner follow-up visits needs to be studied.

Significant differences in medication adherence between prison inmates and nonincarcerated controls were not seen in our study, but the topic merits discussion. Medication administration in prisons varies by patient and by facility. Prisoners may maintain possession of and self-administer their medications (so-called Keep-on-Person administration) or the medications may be held by the prison and administered by the prison staff. The specific type of medication administration for each patient was not readily available for analysis. Various issues may dictate which administration policy is favored; for example, some medication classes – such as psychotropic medications – may be used for unintended purposes in prisons. There is debate as to the optimal method of medication administration in prisons.<sup>16,17</sup> Even when scheduled medications are administered by prison staff, prisoners still have the right to refuse their medications. Patients reporting medication nonadherence may be reflecting their own refusal of medication, their own

failure to self-administer medications, or an inadequacy in the prison's provision of medications. Moreover, accurate assessment of medication adherence is challenging. This study used self-reporting as a metric for medication compliance, which may introduce inaccuracy. However, other methods of assessing medication compliance have shortcomings as well.<sup>18</sup> In addition, in this study, there were a substantial number of treatment-naïve prisoners who were seen at an initial visit where a medication was recommended and who were subsequently lost to follow-up. These patients could not be included in medication compliance analysis. Given that prisoners had far fewer clinical visits than controls, it is likely that overall adherence rates were underestimated in prisoners in this study. Estimates of treatment adherence among prisoners are notably inconsistent and may vary widely by prison, by population, and by disease.<sup>19-21</sup> Therefore, more rigorous assessments of adherence, or indeed longer term follow-up to assess disease progression as a surrogate for treatment adherence, is important.

Significant differences were found in visual field testing rates between the two study groups, while OCT imaging was performed at a similar rate. This difference likely occurred because optic nerve imaging could be ordered and performed at the same visit, whereas visual field testing required pre-scheduling at this academic center. Loss to follow-up even in the control group resulted in a lower-than-expected rate of OCT imaging. In addition, OCT imaging was forgone in end-stage patients due to the expected floor effect and lack of utility in OCT imaging in assessing for progression in these patients.

Our study was limited by its small sample size. While our findings were statistically significant, they may not be generalizable to other states and countries. In addition, while a race- and sex-matched control population was intended to limit confounding factors, the specific composition of the imprisoned study group (high percentage black and all male) is unique makes the study findings less generalizable. Even with a large sample size and diverse study population, many of the factors affecting medication and follow-up adherence may be prison system-dependent and therefore less applicable in other states and countries.

Control patients were selected who lived within close proximity to the clinic and with government-issued health insurance to compare prisoners with prison-funded transportation and state-funded health insurance to control patients with low systematic barriers to accessing healthcare. However, this may artificially underestimate delays in care and loss to follow-up in the general nonincarcerated population.

This study was limited in its ability to elucidate treatment outcomes in this population. Due to the limited follow-up time frames, especially in prisoners, visual field and OCT progression could not be studied. Furthermore, limitations in the electronic medical record system precluded a more extensive historical study time range. The study of surgical

outcomes was similarly limited, due to the low number of surgical procedures performed. Given the importance of close follow-up in the immediate postoperative period, the obstacles involved in outpatient follow-up adherence may manifest as significant functional and outcomes issues if studied on a larger scale.

While effort was made to find comparable nonincarcerated controls, it is possible that the prisoners being seen at our institution represent a unique population among prisoners with glaucoma. Local prisons in our study have healthcare providers, including an eye care professional, who provide more routine care for most patients with glaucoma. Specific details regarding subjects' in-prison eye care before referral or indeed possibly between visits at our institution were unavailable for the study. Education may be a confounding factor in this study, but education level was not routinely obtained for patients in the clinic and could not be assessed for each patient.

In conclusion, our study has been the first to directly compare follow-up and management of prisoners and nonincarcerated patients with glaucoma. Follow-up visits occur at a significantly lower rate and are significantly delayed when compared to nonincarcerated patients. Further study into the causes of these differences coupled with studies of disease progression in this population is warranted.

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### **Conflicts of interest**

There are no conflicts of interest.

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