# META-ANALYSIS

# The Incidence and Risk Factors of Optic Nerve Damage of Posner-Schlossman Syndrome: A Meta-Analysis

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### ABSTRACT

**Objective** • To explore the incidence and associated factors of glaucoma optic nerve damage (GOND) among patients with Posner-Schlossman syndrome.

**Methods** • We retrieved relative studies till July 2022 using databases including PubMed, CNKI, VIP, and Wan-Fang. The retrieval terms include "Posner-Schlossman syndrome", "Glaucomatocyclitic Crisis", and "visual field". The Chinese retrieval terms were the corresponding Chinese terminologies for the English terms mentioned above. The outcomes were the incidence of GOND among PSS patients, the male proportion, patient age, the proportion of patients with single eye affected, disease duration, and intraocular pressure during the episode in patients with or without GOND. Review manager 5.3 was used for the analysis.

**Results** • In total, 19 studies were included in our analysis. The pooled incidence of GOND among PSS patients was

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# INTRODUCTION

Glaucomatocyclitic crisis was reported by Posner and Schlossman in 1948 and hence it was also named Posner-Schlossman's syndrome (PSS).<sup>1-3</sup> PSS is a type of secondary glaucoma and presents an increased intraocular pressure (IOP) accompanying non-granulomatous uveitis.<sup>3</sup> It is more common among males aged between 20-50 years.<sup>4</sup> Single eye affected is more common while both eyes affected is rare. Intraocular pressure recurrently increases, which may reach 4-60 mmHg and last 1-14 days with intermission of a few months to 2 years.<sup>4</sup> The visual acuity is generally normal and light reflection is normal. Keratic precipitate (KP) usually 0.26 (95% CI = 0.16-0.43). Age [MD = 11.3(5.86, 16.73); P < .0001], disease duration [MD = 4.27 (3.38, 5.16), P < .00001], and single or double eye affected [RR = 0.69 (0.49, 0.98), P = .04] were significantly associated with the development of GOND. Whereas, gender [RR = 1.09 (0.91, 1.29), P = .35] and intraocular pressure at episodes [MD = 2.66 (-0.38, 5.7), P = .09] were not significantly associated with GOND development.

**Conclusion** • A fraction of PSS patients ultimately develop GOND so physicians should not be highly optimistic about the prognosis of PSS patients and timely and effective treatment is very important. Patients of higher age, those with double eyes affected, and suffering from a long disease duration might be at a greater risk of developing GOND. (*Altern Ther Health Med.* 2023;29(8):384-388).

occurs a few days before or after intraocular pressure increases, and after the IOP returns to a normal level, KP may persist for several days to one month. Anterior chamber angle opens and in most cases visual field and fundus are normal.<sup>4</sup>

In most PSS cases, IOP quickly returns to a normal level after treatment, the anterior uveitis is gradually relieved, and the visual acuity is usually not significantly impacted.<sup>5-7</sup> Therefore, in early reports, PSS was considered to have a good prognosis where visual disc or visual field damage is rare, and thus different from glaucoma.8 However, with further investigation, researchers have observed irreversible glaucoma optic nerve damage (GOND) among patients with recurrent PSS or those with a long persisting course or long disease duration.<sup>9,10</sup> In the 9 cases of PSS reported by Posner, one patient was showing visual disc and visual field damage.1 In the study performed by Jap A et al among 50 PSS patients (53 eyes), 14 patients finally developed glaucoma.<sup>10</sup> Furthermore, he reported that the possibility of developing glaucoma in patients with over 10 years' disease duration was 2.8 fold higher than those with a disease duration of less than 10 years.<sup>10</sup> Li et al reported that the incidence of PSS in patients comorbid with primary open-angle glaucoma was

31%.<sup>7</sup> There are also several reports of comorbid PSS with angle closure glaucoma or other eye diseases.<sup>5,6,8,9</sup>

Currently, the incidence and associated factors of GOND among PSS patients are not yet clear. Therefore, in the present meta-analysis, we reviewed the relevant literature and explored the incidence and factors associated with GOND.

# METHODS AND MATERIALS

#### Literature retrieval

We retrieved relevant studies till July 2022 in databases including PubMed, Wan-Fang, VIP and CNKI. The retrieval terms include "Posner-Schlossman syndrome", "Glaucomatocyclitic Crisis", and "visual field". The Chinese retrieval terms were corresponding Chinese terminologies for the English terms mentioned above. The references to important articles were manually retrieved.

### Inclusion criteria and exclusion criteria

**Inclusion criteria**: (1) type of studies: for analysis of the incidence of visual field damage, all kinds of clinical studies were included; for analysis of associated factors, cross-section studies compared PSS patients with visual field damage and PSS patients without visual field damage were included; (2) participants of studies: patients diagnosed with PSS and disease which may induce optic nerve impairment were excluded; (3) outcomes: for analysis of incidence of visual field damage among PSS patients, the total number of PSS patients and the number of patients with glaucoma optic nerve damage (GOND) were provided; for the analysis of associated factors, outcomes included gender, age, disease duration, IOP of episodes, and single or double eyes.

**Exclusion criteria**: (1) review articles or meeting reports were excluded; (2) duplicate studies were excluded.

#### Literature screening, data extraction, and quality assessment

Two independent researchers made literature screening by examining duplication, title, abstract, and finally the main text. Disagreement in screening results by the two reviewers was resolved through discussion or judgment by a third experienced researcher. The extracted data included author, publication year, sample size, gender, and age. For the analysis of associated factors, additional data included single or double eyes, disease duration, and IOP during the episode. Cross-sectional/prevalence Study Quality, Agency for Healthcare Research and Quality was used for quality assessment since the study is a cross-sectional one.<sup>11</sup> For each study, 11 domains were assessed, which are listed in Table 2.

### **Outcome measurement**

The measurements included GOND rate among PSS patients, male proportion (analysis of gender as a factor of GOND), age, single eye proportion (analysis of single or double eye as a factor of GOND), disease duration, and IOP during the episode. GOND rate = number of eyes with GOND/number of total eyes; male proportion = number of males/number of total patients; single eye proportion =

number of patients with single eye affected/number of patients with double eyes affected.

#### **Statistical Analysis**

Review manager 5.3 and Stata were used to perform Meta-analysis. Relative risk (RR) was calculated to compare the categorical variants between the patient group with visual field damage and the patient group without visual field damage. The mean difference (MD) was calculated to compare the continuous variants between the two groups. The comparative results were expressed with effect size and 95% confidence intervals (CI). The meta-analysis with non-comparative binary data was performed following the method described by Chen et al.<sup>12</sup> The heterogeneity was tested with a standard chi-squared ( $I^2$ Q) test. If  $I^2 > 50\%$ , heterogeneity was used; if  $I^2 < 50\%$ , heterogeneity was not assumed to be significant and the fixed effect model was sued. P < .05 was considered to be statistically significant.

#### RESULTS

# Literature screening result and characteristics of included studies

Following the retrieval strategy, 25 studies were obtained. Among the initial 25 studies, 3 studies could be retrieved from PubMed; 20 studies could be retrieved from CNKI; 13 studies could be retrieved from Wan-Fang; 12 studies could be retrieved from VIP. After duplication examination, no article was excluded. After examination of the title and abstract, 2 articles were excluded due to being case reports. After examination of the main text, 4 articles were excluded due to lack of outcome of visual field examination or optic nerve injury. Finally, 19 studies were included in the present studies. The process of literature screening has been shown in Figure 1.





Table 1. Characteristics of Studies Included in the Analysis for the Incidence of Visual Field Impairment Among PSS Patients

Author & year	Sample size (patient/eye)	Gender (M/F)	Single /double eyes (patient)	Age range (mean ± SD)	GOND (patient/eyes)
Chen JH, 201913	48/61	30/18	35/13	22-4 9(33.20 ± 5.60)	2/2
Deng J, 201914	48/51	27/21	45/3	17-65 (36.51 ± 8.75)	1/1
Fu P, 200415	39/41	25/14	37/2	28-54 (38.30 ± 10.33)	7/7
Gu SC, 201816	36/39	33/3	33/3	18-56 (30.20 ± 15.60)	8/9
Guo HF, 202017	68/78	45/23	58/10	18-63 (45.01 ± 11.76)	18/22
Jap A, 200110	50/53	28/22	47/3	35.00	13/14
Jiang YN, 201918	50/50	43/7	50/0	18-61 (38.89 ± 4.17)	4/4
Li Yanying, 202019	146/146	89/57	146/0	35-55 (45.30 ± 16.18)	109/109
Liu ZH, 2012 <sup>20</sup>	49/55	30/19	43/6	18-62 (37.20 ± 15.60)	6/7
Luo Q, 200921	32/36	21/11	28/4	18-56 (32.00 ± 14.20)	4/4
Maryyama,K, 201722	33/33	18/15	33/0	51.80 ± 18.90	21
Qiao JH, 201523	32/36	22/10	28/4	22-51 (28.50 ± 1.50)	4/4
Sun L, 201724	56/56	33/23	NP	23-55 (42.40 ± 11.40)	8/8
Tang YL, 2010 <sup>25</sup>	42/55	25/17	29/13	(36.00 ± 11.60)	14/25
Wang H, 201726	147/165	90/57	129/18	18-62 (39.20 ± 14.30)	48/58
Wang SH, 200527	48/52	27/21	44/4	19-73	6/6
Xu XY, 2014 <sup>28</sup>	68/70	40/28	66/2	17-63 (37.51 ± 13.27)	10/10
Zhang AM, 200629	26/27	22/4	25/1	17-53 (35.40 ± 8.70)	1/1
Zhou HZ, 2002 <sup>30</sup>	117/133	66/51	101/16	18-57 (39.21 ± 12.13)	35/55

Abbreviations: GOND, glaucomatous optic nerve damage; SD, standard deviation; NP, not provided.

Table 2. Characteristics of Studies Included in Analysis for Relative Factors of Visual Field Impairment Among PSS Patients

	Sample size	Gende	r (M/F)	A	ge	One eye	'two eyes	Disease	duration	IOP of	episodes
Author& year	(P/E)	G	NG	G	NG	G	NG	G	NG	G	NG
Guo HF, 202017	68/78	13/5	32/18	$48.06 \pm 13.50$	$41.95 \pm 10.03$	14/4	44/6	$10.41\pm6.72$	$3.22 \pm 2.05$	$47.24 \pm 6.50$	$47.06 \pm 7.20$
Tang YL, 201025	42/55	9/5	12/16	$48.34 \pm 12.38$	32.47 ± 12.35	3/11	26/2	$8.25 \pm 3.24$	$4.16 \pm 2.24$	37.35 ± 8.22	$34.26 \pm 8.37$
Wang H, 201726	147/165	30/18	60/39	$49.23 \pm 11.67$	33.29 ± 11.89	38/10	91/8	$9.12 \pm 3.67$	$5.21 \pm 2.78$	38.22 ± 7.78	$32.26 \pm 7.86$
Zhou HZ, 200230	117/133	20/15	46/36	$42.84 \pm 12.00$	35.57 ± 12.26	20/15	81/1	8.77 ± 7.22	4.36 ± 3.33	37.14 ± 9.12	36.22 ± 9.23

Abbreviations: GOND, glaucomatous optic nerve damage; POAG, primary open-angle glaucoma; PSS, Posner-Schlossman syndrome; IOP, intraocular pressure; KP, keratic precipitate; M, male; F, female; P, patients; E, eyes; G, GOND; NG, No GOND.

The characteristic of the 19 studies included are summarized in Table 1.<sup>10, 13-28</sup> Two studies were published in English medical journals and the rest 17 studies were all published in Chinese medical journals. The publication year ranged from 2001 to 2020. All studies reported the number of patients and the number of eyes affected. A few studies only reported number of patients having GOND, but not the number of eyes affected. In these cases, the number of eyes affected having GOND was considered to be the same as the number of patients having GOND. The quality assessment results have been summarized in Table 3, which shows that the overall quality of included studies is not high.

# Outcomes

**Incidence of GOND among PSS patients.** 19 studies with 1173 eyes were included in the present analysis. The result of the heterogeneity test demonstrated that there was a significant difference between the studies included (P < .01,  $I^2 = 91\%$ ), so a random effect model was employed. The analysis demonstrated that the pooled incidence of GOND among PSS patients was 20% with 95% CI = 0.13-0.30 (Figure 2).

**GOND associated factors.** Four studies with 374 patients were included in the analysis for GOND-associated factors.

Upon comparison of gender between the GOND group and no GOND group using the heterogeneity test, the result demonstrated no significant difference between the included studies (P=.68, I<sup>2</sup>=0), so the fixed effect model was used. The analysis result demonstrated that the male proportion of the GOND group was not significantly different from the no **Table 3.** Domains of Cross-Sectional/Prevalence StudyQuality, Agency for Healthcare Research and Quality

Domain	Content
1	Define the source of information (survey, record review)
2	List inclusion and exclusion criteria for exposed and unexposed subjects (cases and
	controls) or refer to previous publications
3	Indicate the time period used for identifying patients
4	Indicate whether or not subjects were consecutive if not population-based
5	Indicate if evaluators of subjective components of the study were masked to other
	aspects of the status of the participants
6	Describe any assessments undertaken for quality assurance purposes (e.g., test/retest of
	primary outcome measurements)
7	Explain any patient exclusions from the analysis
8	Describe how confounding was assessed and/or controlled
9	If applicable, explain how missing data were handled in the analysis
10	Summarize patient response rates and completeness of data collection
11	Clarify what follow-up, if any, was expected and the percentage of patients for which
	incomplete data or follow-up was obtained

**Table 4.** Risk of Bias of Included Studies: Cross-Sectional/Prevalence Study Quality, Agency for Healthcare Researchand Quality (AHRQ)

Author & year	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
Deng Jing 2019	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Fu Pei 2004	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Gu Shicai 2018	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Guo Huafang 2020	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Jap A 2001	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Jiang Yanni 2019	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Li Yanying, 2020	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Liu Zhiheng 2012	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Luo Qian 2009	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Maryyama,K, 2017	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Qiao Jianhua 2015	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Sun Liang 2017	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Tang Yilin 2010	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Wang Hui 2017	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Wang Shaohua 2005	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Xu Xingyan 2014	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Zhang Aimin 2006	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Zhang Aimin 2006	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA
Zhou Hezheng 2002	Y	Y	Y	Y	Ν	Y	Ν	Ν	Ν	Y	NA

Abbreviations: Y, Yes; N, No; U, Unclear; NA, Not applicable; D1-D11, Domain1-Domain11.





# Figure 4. Comparison of Age Between GOND Group and No GOND Group

	Exp	eriment	tal	(	Control			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Guo Huafang 2020	48.06	13.5	18	41.95	10.03	50	22.7%	6.11 [-0.72, 12.94]	
Tang Yilin 2010	48.34	12.38	14	32.47	12.35	28	20.1%	15.87 [7.93, 23.81]	
Wang Hui 2017	49.23	11.67	48	33.29	11.89	99	29.5%	15.94 [11.89, 19.99]	
Zhou Hezheng 2002	42.84	12	35	35.57	12.26	82	27.7%	7.27 [2.49, 12.05]	-
Total (95% CI)			115			259	100.0%	11.30 [5.86, 16.73]	•
Heterogeneity: Tau <sup>2</sup> =	21.77; C	hi²=11	.15, df	= 3 (P =	0.01); P	= 73%			
Test for overall effect.	Z = 4.08	(P < 0.0	001)						Favours [experimental] Favours [control]

GOND group [RR =1.09 (0.91,1.29), P=.35] (Figure 3). This result indicated gender is not a factor associated with the development of GOND.

Upon comparison of age between the GOND group and no GOND group, the heterogeneity test result demonstrated a significant difference between the studies included (P=.01, P= 73%), so a random effect model was used. The analysis result demonstrated that the age of the GOND group was significantly higher than that of the control group [MD = 11.3 (5.86, 16.73); P<.0001] (Figure 4). This result suggested that increased age (elderly) might be one factor associated with GOND.

Upon comparison of the number of patients with single or double eyes between the GOND and no GOND group, the heterogeneity test result demonstrated that the studies included was significantly different (P = .001,  $I^2 = 81\%$ ), so the random effect model was used. The analysis result demonstrated that the proportion of patients with single eye affected in the GOND group was significantly lower than that in the no GOND group [RR = 0.69 (0.49, 0.98), P = .04] (Figure 5). This result suggested that the condition where both eyes are affected might be one of the factors associated with GOND.

Upon comparative evaluation of the disease duration between the GOND group and the no GOND group, the

# **Figure 5.** Comparison of Single or Double Eyes Between GOND Group and No GOND Group

	Experim	ental	Contr	ol		<b>Risk Ratio</b>	Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	M-H, Random, 95% CI
Guo Huafang 2020	14	18	44	50	29.4%	0.88 [0.68, 1.15]	-8-
Tang Yilin 2010	3	14	26	28	8.9%	0.23 [0.08, 0.63]	
Wang Hui 2017	38	48	91	99	33.1%	0.86 [0.74, 1.01]	+
Zhou Hezheng 2002	20	35	81	82	28.6%	0.58 [0.43, 0.77]	-
Total (95% CI)		115		259	100.0%	0.69 [0.49, 0.98]	•
Total events	75		242				
Heterogeneity: Tau <sup>2</sup> =	0.09; Chi <sup>2</sup> :	= 16.11,	df = 3 (P	= 0.00	1); I <sup>2</sup> = 81	%	
Test for overall effect:	Z = 2.10 (P	= 0.04)					U.05 U.2 1 5 20 Favours [experimental] Favours [control]

**Figure 6.** Comparison of Disease Duration Between GOND Group and No GOND Group

	Expe	erimen	tal	C	ontrol			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI	IV, Fixed, 95% CI
Guo Huafang 2020	10.41	6.72	18	3.22	2.05	50	7.9%	7.19 [4.03, 10.35]	
Tang Yilin 2010	8.25	3.24	14	4.16	2.24	28	22.1%	4.09 [2.20, 5.98]	
Wang Hui 2017	9.12	3.67	48	5.21	2.78	99	57.3%	3.91 [2.74, 5.08]	
Zhou Hezheng 2002	8.77	7.22	35	4.36	3.33	82	12.7%	4.41 [1.91, 6.91]	
Total (95% CI)			115			259	100.0%	4.27 [3.38, 5.16]	•
Heterogeneity: Chi2 =	3.70, df=	: 3 (P =	: 0.30);	P= 199	6				
Test for overall effect.	Z=9.43	(P < 0.)	00001)						Favours [experimental] Favours [control]

**Figure 7.** Comparison of IOP at Episodes Between GOND Group and No GOND Group

	Expe	erimen	tal	C	ontrol			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Guo Huafang 2020	47.24	6.5	18	47.06	7.2	50	25.7%	0.18 [-3.43, 3.79]	
Tang Yilin 2010	37.35	8.22	14	34.26	8.37	28	18.1%	3.09 [-2.22, 8.40]	
Nang Hui 2017	38.22	7.78	48	32.26	7.86	99	30.6%	5.96 [3.27, 8.65]	
Zhou Hezheng 2002	37.14	9.12	35	36.22	9.23	82	25.6%	0.92 [-2.70, 4.54]	
Total (95% CI)			115			259	100.0%	2.66 [-0.38, 5.70]	•
Heterogeneity: Tau <sup>2</sup> =	5.98; Ch	P= 8.2	5. df=	3 (P = 0	.04); P	= 64%			<u></u>
fest for overall effect	Z=1.72	(P = 0)	09)						-10 -5 0 5 10
									Pavouis (experimental) Pavouis (control)

heterogeneity test result demonstrated that the studies included were not significantly different (P = .3,  $I^2$  = 19%), so a fixed effect model was used. The analysis result demonstrated that the disease duration of the GOND group was significantly longer than that of no GOND group [MD = 4.27 (3.38, 5.16), P < .00001] (Figure 6). This result suggested that longer disease duration might be one of the factors associated with the development of GOND.

Comparison of IOP during the episodes between the GOND group and the no GOND group using the heterogeneity test revealed that there was a significant difference between the studies included (P = .04,  $I^2 = 64\%$ ), so a random effect model was used. The result demonstrated that the IOP during the episodes of the two groups was not significantly different [MD = 2.66 (-0.38, 5.7), P = .09] (Figure 7). This suggested that IOP during the episodes might not be one of the factors associated with GOND among PSS patients.

### DISCUSSION

Although previously Posner and Theader proposed that the visual disc and visual field impairment were not involved in PSS,<sup>1,31</sup> some published cases afterward had reported instances of the visual disc or visual field impairment.<sup>7</sup> Based on our analysis, the pooled incidence of GOND among PSS patients was 20% (95% CI = 0.13-0.30). Our results have confirmed that GOND may occur in some of the PSS patients. Our findings also suggest that physicians should not be optimistic about the prognosis of PSS in patients, and timely and effective treatment is of utmost importance.

The glaucomatous optic nerve damage is irreversible and the condition severely threatens the quality of life in patients. Identification of the associated factors will benefit early intervention and help to reduce optic nerve damage.

In the present study, we investigated the associated factors of GOND and the result demonstrated that elder age, double eye affected condition, and disease duration might be the factors associated with GOND, while gender and IOP during the episodes might not be associated with GOND. The study performed by Jap A et al showed that the risk of GOND in PSS patients with over 10 years of disease duration was 2.8-fold of that of patients with less than 10 years of disease duration.<sup>10</sup> The researchers suggested that long disease duration was one of the factors associated with nerve impairment. Our finding was consistent with this conclusion.

It is known that PSS patients show alterations of the optic papilla during the acute phase. This alteration is similar to the optic nerve alteration in glaucoma, however, it is transient and reversible. Differing from simple chronic glaucoma with persistent high intraocular pressure, PSS presents sudden increased IOP which is beyond the automatic regulation system and leads to a decrease of blood flow in the retina. However, this infusion is transient, and the blood flow recovers after an acute attack, and the various measurements of the visual disc becomes normal within four months. This is the key reason why PSS was not associated with the induction of visual field alteration or optic nerve atrophy. However, some researchers proposed that recurrent attacks of GOND, severe inflammation, and long-term intraocular pressure in PSS, may lead to trabecular reticulum impairment and PSS secondary glaucoma. This may explain why long disease duration and increased age (elderly) might be associated factors of GOND among PSS patients.

Some studies did not investigate the factors associated with GOND among PSS patients through clinical studies but discussed it. Raitta C proposed that treatment strategy (for example long-term usage of steroids) may contribute to the development of GOND.32 In clinical practice, some PSS patients had a recurrence and shorter intermission which would lead to the long-term usage of steroids, which may in turn lead to reduced aqueous humor outflow, increased intraocular pressure, and even optic nerve damage. Thus, this might be one of the factors associated with visual field impairment in PSS patients. Furthermore, some studies had proposed that the factors associated might also include the duration of each episode, the number of episodes, and the family history of glaucoma or anterior chamber angle problem.<sup>26</sup> Due to limited published evidence, our analysis could not include these factors for further analysis. Therefore, future studies are warranted to evaluate these factors.

This is the first meta-analysis investigating the incidence and the factors associated with GOND among PSS patients. This finding is important for clinical practices since patients having one or more associated factors should receive more attention for visual function in their clinical visit and follow-up. However, the number of studies included was small and the quality of included studies was not high, which may lead to certain biases.

#### CONCLUSION

A fraction of the PSS patients ultimately develop GOND, so physicians should not be optimistic about the prognosis of PSS patients and timely and effective treatment is very necessary. Patients with higher age, double eye affected, and long disease duration should receive adequate attention to prevent the development of GOND.

#### AUTHOR DISCLOSURE STATEMENT

The authors declare that they have no conflicts of interest

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