

Original Article

Disposable protective eye masks can reduce postoperative infection and promote wound healing in patients undergoing ophthalmic surgery

Hongqing Qiao¹, Xing Huang²

¹Department of Ophthalmology, Beijing Friendship Hospital, Capital Medical University, Beijing 100050, China;

²International Medical Center, Beijing Friendship Hospital, Capital Medical University, Beijing 100050, China

Received July 27, 2020; Accepted September 11, 2020; Epub January 15, 2021; Published January 30, 2021

Abstract: Objective: This paper aimed to explore the effects of disposable protective eye masks (DPEM) in nursing care on the postoperative infection (POI) and wound healing of patients undergoing ophthalmic surgery. Methods: Surgical treatment in the ophthalmology department of our hospital from May 2018 to October 2019, was performed on 200 patients who were selected and divided into two groups. Those in the study group (n = 104) received DPEM nursing, and those in the control group (n = 96) received the routine nursing with conventional eye covering. Both groups were observed in terms of their overall response rates (ORRs), their postoperative recovery (time of congestion regression, healing time, hospital stay), and compliance, comfort, convenience, and usage of eye masks. Before and after intervention, the expression levels of inflammatory cytokines (IL-6, IL-10, and CRP) were detected; the patients' anxiety and depression status, self-care abilities, sleep quality, and nursing satisfaction were assessed. Results: After intervention, the ORR in the study group was remarkably higher than that in the control group; the time of congestion regression, the healing time, and the hospital stays were remarkably shorter in the study group; the compliance, comfort, convenience, and feasibility of the eye masks were remarkably better in the study group; the expression levels of IL-6 and CRP were remarkably lower, while those of IL-10 were remarkably higher in the study group; the SAS, SDS, and SDRS scores were remarkably lower while the scores of each item in the ESCA were remarkably higher in the study group; and the nursing satisfaction was remarkably higher in the study group. Conclusion: For patients undergoing ophthalmic surgery, in addition to reducing ocular infections, promoting wound healing in the eyes, and increasing compliance and comfort, DPEM nursing can also relieve negative emotions, enhance self-care abilities and sleep quality, and improve nursing satisfaction.

Keywords: Ophthalmic surgery, disposable protective eye masks, postoperative infection, wound healing

Introduction

As an important human sensory organ, the eyes are required for a normal life and ability to work [1]. With the modern development of society and the progress of science and technology, the incidence of ophthalmic diseases has been rising annually; the eye diseases seriously affect patients' normal life and work, and untimely and ineffective treatment of them easily causes blindness and other disabilities [2]. At present, eye diseases are mainly treated by surgery [3], after which it is important to improve therapeutic effects and reduce adverse reactions to protect the operated upon eyes and to prevent injury and infection [4, 5]. Clinically, eye coverings are commonly used,

during which the operated upon eyes are covered with gauze which is fixed with adhesive tape. However, this conventional fixation method easily leads to injury or infection due to loose and caducous fixation, and can cause allergy and irritation at the sticking position and results in difficulties removing the adhesive tape residue [6, 7]. Therefore, in clinical nursing of ophthalmology, continuous exploration and improvement is needed to improve surgical dressing, protect the operated upon eyes, and prevent ocular infections [8].

“Disposable protective eye masks (DPEMs)” used in this study are protective eye masks that are skillfully made by disposable masks in clinical work [9]. In hospitals, sufficient and con-

venient materials (such as disposable mouth masks and infusion stickers) and their low prices are helpful to reduce the economic burden of patients and facilitate their acceptance. Since the patients need to protect the eyes that were operated on and dressing fixation is a necessary measure, improper fixation results in allergic reactions and complications including infection [10]. DPEMs have soft texture, satisfactory permeability, and have no need to be fixed with adhesive tape, so this solves the problem of adhesive tape residue that is difficult to remove and can thus reduce allergic reactions [11]. After surgery, eye drops are frequently used for the operated-on eyes and eye masks are frequently worn and taken off, and the DPEMs cause no damage to the eyes because they are very convenient to wear and take off [12]. On one hand, they reduce the risk of infection because of their large coverage area and firm fixation. On the other hand, they improve the comfort of patients and avoid postoperative injuries that can be created by wind and sand [13]. However, there is very little research on the application of DPEMs for patients undergoing ophthalmic surgery.

In this study, the patients were given DPEM in nursing care to discuss the effects of this intervention model on their postoperative infection (POI) and wound healing.

Materials and methods

General information

Surgical treatment was performed in the Ophthalmology Department of Beijing Friendship Hospital, Capital Medical University from May 2018 to October 2019, in which 200 patients were selected and divided into the study and control groups based on different nursing intervention. Those in the study group ($n = 104$) received DPEM nursing, and those in the control group ($n = 96$) received the routine nursing and conventional eye covering. The control group consisted of 54 males and 42 females, who were aged 18-65 years, with an average age of 40.20 (± 4.68) years. The study group consisted of 60 males and 44 females, who were aged 18-66 years with an average age of 41.01 (± 4.36) years.

Inclusion and exclusion criteria

Inclusion criteria: (1) All patients were treated with ophthalmic surgery and had surgical indi-

cations [14]. (2) All patients underwent monocular surgery. (3) All patients were aged ≥ 18 years. (4) All patients were classified with Grade I-II by the American Society of Anesthesiologists (ASA) [15]. (5) This study was approved by the Ethics Committee of our hospital. The research subjects and their families were informed and they signed a fully informed consent form.

Exclusion criteria: (1) Those with contraindications to surgical anesthesia; (2) Those complicated with severe organ (such as heart, liver, lung, and kidney) diseases; (3) Those complicated with infectious and immune system diseases; (4) Those with end-stage chronic diseases and malignant tumors; (5) Those with cognitive, language, and hearing impairment; (6) Those complicated with mental illness or a family history of mental illness; (7) Those with incomplete general clinical data and who withdrew from this experiment halfway.

Methods of nursing interventions

Patients in the control group were treated with routine nursing of conventional eye covering. After sterile gauze and adhesive tape was used for postoperative dressing and for covering the operated-on eyes, the patients were given medication guidance to prevent infection of surgical wounds. Health education, postoperative dietary guidance, and other routine nursing measures were also given to them.

Patients in the study group were given DPEM: the self-made DPEMs from our hospital were applied to the postoperative protection of the operated-on eyes. The specific methods were as follows:

Firstly, a DPEM was made: a disposable mouth mask was taken out, folded in half left and right, and then divided into left and right parts (the positions of left and right eyes). The edge of the mouth mask with the nose bridge shaping silk was pulled down as the lower part of the eye mask. One side of the protected eye (the operated eye) was kept stationary, while in the central part of the other side (the right side of the mouth mask if the left eye was protected), the part with the same size as an eye was cut out to form an eye-shaped hole. For keeping the edge neat, the easy-to-drop edge hairs were removed, and the edge was wrapped with the fixed strips of the infusion stickers, so as

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to ensure the edge was neat and helped to increase the comfort.

Secondly, the patients were instructed to wear the DPEM, which was worn on the eyes like a mouth mask. The left and right sidebands were respectively worn behind the two ears, and the eyes were kept under the center of the mask. The plastic edge of the upper part was folded inward to make it close to the forehead, and the edge of the lower part was folded inward. After that, the plastic silk inside the edge was pressed to make it be in close contact with the nose bridge, so that the lower edge of the mask was close to the nose and the cheek, in order to make the mask have a protective effect.

Finally, postoperative patients were given individualized health education, psychological counseling, guidance on preventing postoperative complications, medication guidance, and increased communication.

Outcome measures

(1) Overall response rates (ORRs): Markedly effective indicates that clinical symptoms disappeared completely and vital signs returned to normal, with no adverse reactions such as infection. Effective indicates that the clinical symptoms were remarkably relieved and the vital signs basically returned to normal, with few adverse reactions such as infection. Ineffective indicates that the clinical symptoms and the vital signs were not relieved remarkably, with adverse reactions such as infection. $ORR = (\text{Markedly effective} + \text{effective cases}) / \text{total number of cases} \times 100\%$.

(2) The patients in both groups were observed in terms of their postoperative recovery (time of congestion regression, healing time, hospital stay).

(3) They were also observed in the compliance, comfort, convenience, and fixation of the eye masks; of which the total scores were all 100 points. Higher scores indicate better comfort and compliance.

(4) Levels of inflammatory cytokines: Before and after intervention, 5 mL of fasting venous blood was respectively collected from both groups, and then centrifuged at 2000 r/min (10 minutes, room temperature), so as to obtain the upper serum in which interleukin-6 (IL-6),

interleukin-10 (IL-10), and C-reactive protein (CRP) were detected by enzyme-linked immunosorbent assay (ELISA). The steps were conducted with reference to the instructions of human IL-6, IL-10, and CRP ELISA kits (Gelatin & Protein Co., Ltd., Shanghai, China, JK-(a)-0023, JK-(a)-0032, JK-(a)-1623).

(5) SAS and SDS scores: The Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS) [16] were adopted to assess the patients' anxiety and depression status before and after intervention. The SAS has a total score of 100 points. A score of 50-70 points indicates mild anxiety, and a score of 71-90 points indicates moderate anxiety, and a score of > 90 points indicates severe anxiety. Higher SAS scores indicate more serious anxiety. The SDS has a total score of 100 points. A score of 50-70 points indicates mild depression, and a score of 71-90 points indicates moderate depression, and a score of > 90 points indicates severe depression. Higher SDS scores indicate more serious depression.

(6) Scores of self-care ability: The Exercise of Self-Care Agency Scale (ESCA) [17] was used to evaluate the patients' self-care abilities before and after intervention. The scale consists of self-care skills, sense of self-care responsibility, self-concept, and knowledge and information seeking, with 43 items in total and it uses a 5-grade marking system. Higher ESCA scores indicate stronger self-care abilities.

(7) Scores of sleep quality: The Sleep Dysfunction Rating Scale (SDRS) [18] was used to evaluate the patients' sleep disturbances before and after intervention. There are 10 items in the scale, which is graded on a scale of 0-4 points. Higher SDRS scores indicate worse sleep quality.

(8) The self-made *Nursing Satisfaction Questionnaires* of our hospital were used for scoring, with 20 questions in total. The patients scored the satisfaction with the nursing service, with 5 points for each question. A total score of < 70 points indicates dissatisfied, and a total score of 70-89 points indicates satisfied, and a total score of ≥ 90 points indicates very satisfied. $\text{Nursing satisfaction} = (\text{very satisfied} + \text{satisfied cases}) / \text{total number of cases} \times 100\%$.

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Table 1. Comparison of general information [n (%)] ($\bar{x} \pm sd$)

Categories	Study group (n = 104)	Control group (n = 96)	t/ χ^2 value	P value
Gender			0.042	0.836
Male	60 (57.69)	54 (56.25)		
Female	44 (42.31)	42 (43.75)		
Age (Years)	41.01±4.36	40.20±4.68	1.267	0.206
BMI (kg/m ²)	24.23±3.52	24.46±3.48	0.464	0.643
Marital status			0.307	0.578
Married	55 (52.88)	47 (48.96)		
Unmarried	49 (47.12)	49 (51.04)		
Place of residence			0.508	0.475
City	50 (48.08)	51 (53.13)		
Countryside	54 (51.92)	45 (46.88)		
Nationality			0.222	0.637
Han	84 (80.77)	80 (83.33)		
Ethnic minorities	20 (19.23)	16 (16.67)		
Educational backgrounds			0.025	0.874
≥ Senior high school	51 (49.04)	46 (47.92)		
< Senior high school	53 (50.96)	50 (52.08)		
History of smoking			0.041	0.837
Yes	35 (33.65)	31 (32.29)		
No	69 (66.35)	65 (67.71)		
History of drinking			0.002	0.963
Yes	56 (53.85)	52 (54.17)		
No	48 (46.15)	44 (45.83)		
History of diabetes			0.076	0.781
Yes	30 (28.85)	26 (27.08)		
No	74 (71.15)	70 (72.92)		
History of hypertension			0.005	0.941
Yes	32 (30.77)	30 (31.25)		
No	72 (69.23)	66 (68.75)		
Types of diseases			2.425	0.787
Acute ophthalmic trauma	25 (24.04)	24 (25.00)		
Cataract	20 (19.23)	17 (17.71)		
Glaucoma	14 (13.46)	20 (20.83)		
Retinal detachment	16 (15.39)	14 (14.58)		
Strabismus	21 (20.19)	15 (15.63)		
Tumor removal	8 (7.69)	6 (6.25)		

Statistical methods

SPSS 20.0 (IBM Corp, Armonk, NY, USA) was used to statistically analyze the data. Graph-Pad Prism 7 was used to plot figures. Count data were expressed as [n (%)] and compared between groups by a chi-square test. When the theoretical frequency in the test was less than 5, the comparison was conducted by a chi-square test with correction for continuity. Mea-

surement data were expressed as mean \pm standard deviation ($\bar{x} \pm sd$) and compared between groups by an independent samples t test, with the comparison within groups before and after intervention conducted by a paired t test. $P < 0.05$ indicated a statistically significant difference.

Results

Comparison of general information

There were no significant differences between the study and control groups in general baseline data such as gender, age, body mass index (BMI), marital status, place of residence, nationality, educational backgrounds, history of smoking, history of drinking, history of diabetes, history of hypertension, and types of diseases. See **Table 1**.

Comparison of ORR

After intervention, the ORR in the study group was 95.19%, which was remarkably higher than 83.33% in the control group. See **Table 2**.

Comparison of postoperative recovery

After intervention, the time of congestion regression, the healing time, and the hospital stays in the study group

were remarkably shorter than those in the control group. See **Figure 1**.

Comparison of using eye masks

After intervention, the compliance, comfort, convenience, and usability of eye masks scores in the study group were remarkably better than those in the control group. See **Figure 2**.

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Table 2. Comparison of ORR [n (%)]

Groups	Markedly effective	Effective	Ineffective	ORR (%)
Study group (n = 104)	72 (69.23)	27 (25.96)	5 (4.81)	99 (95.19)
Control group (n = 96)	38 (39.58)	42 (43.75)	16 (16.67)	80 (83.33)
χ^2	-	-	-	19.240
P	-	-	-	< 0.001

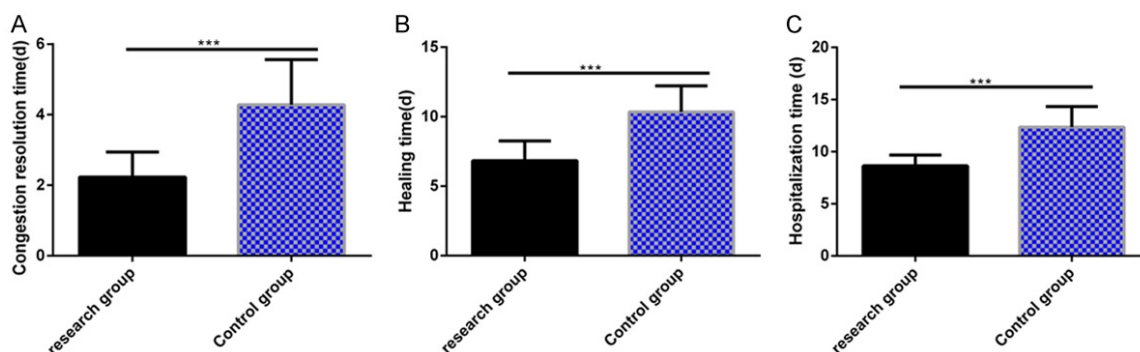


Figure 1. Comparison of postoperative recovery. A. After intervention, the time of congestion regression in the study group was remarkably shorter than that in the control group. B. After intervention, the healing time in the study group was remarkably shorter than that in the control group. C. After intervention, the length of hospital stay in the study group was remarkably shorter than those in the control group. Note: *** indicates $P < 0.001$.

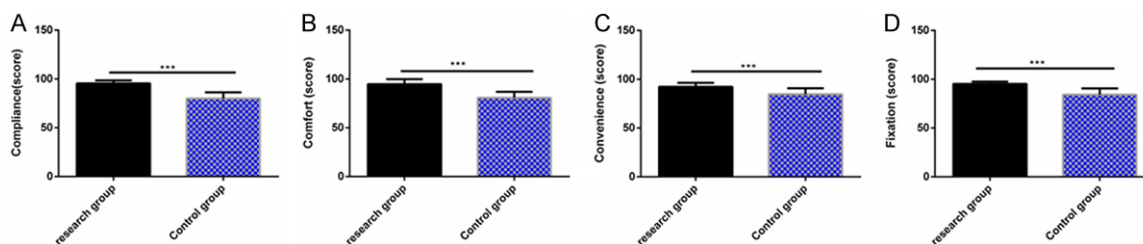


Figure 2. Comparison of using eye masks. A. After intervention, the compliance scores of using eye masks in the study group were remarkably better than those in the control group. B. After intervention, the comfort scores of using eye masks in the study group were remarkably better than those in the control group. C. After intervention, the convenience scores of using eye masks in the study group were remarkably better than those in the control group. D. After intervention, the placement fixation scores of using eye masks in the study group were remarkably better than those in the control group. Note: *** indicates $P < 0.001$.

Comparison of inflammatory cytokine levels

Before intervention, there were no significant differences in the levels of IL-6, IL-10, and CRP between the study and control groups. After intervention, IL-6 and CRP levels remarkably reduced but IL-10 levels remarkably rose in both groups; IL-6 and CRP levels were remarkably lower but IL-10 levels were remarkably higher in the study group. See **Figure 3**.

Comparison of SAS and SDS scores

Before intervention, there were no significant differences in SAS and SDS scores between

the study and control groups. After intervention, the scores in both groups remarkably reduced, and they were remarkably lower in the study group. See **Figure 4**.

Comparison of scores of self-care ability

Before intervention, there were no significant differences between the study and control groups in the scores of self-care skills, sense of self-care responsibility, self-concept, and knowledge and information seeking, and ESCA scores. After intervention, the five scores remarkably rose in both groups, and the scores

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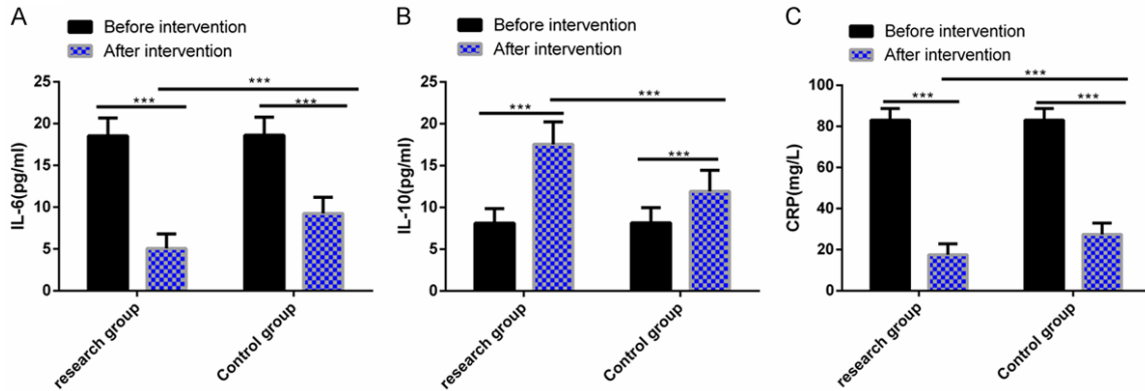


Figure 3. Comparison of inflammatory cytokine levels. A. Before intervention, IL-6 levels were not significantly different between the two groups. After intervention, the levels in both groups were remarkably reduced, and they were remarkably lower in the study group. B. Before intervention, IL-10 levels were not significantly different between the two groups. After intervention, the levels in both groups remarkably rose, and they were remarkably higher in the study group. C. Before intervention, CRP levels were not significantly different between the two groups. After intervention, the levels in both groups remarkably reduced, and they were remarkably lower in the study group. Note: *** indicates $P < 0.001$.

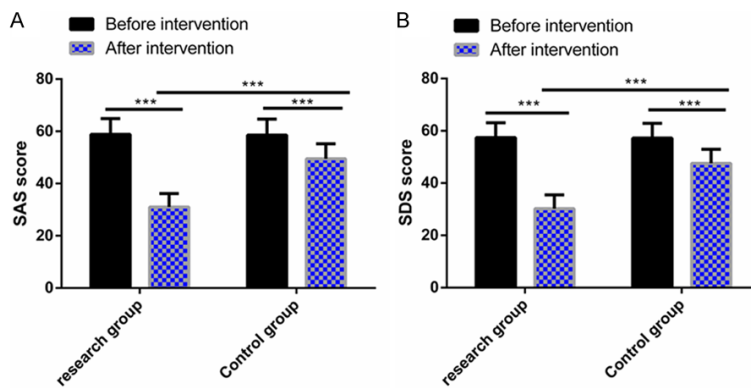


Figure 4. Comparison of SAS and SDS scores. A. Before intervention, SAS scores were not significantly different between the two groups. After intervention, the scores in both groups remarkably reduced, and they were remarkably lower in the study group. B. Before intervention, SDS scores were not significantly different between the two groups. After intervention, the scores in both groups remarkably reduced, and they were remarkably lower in the study group. Note: *** indicates $P < 0.001$.

of each item in the ESCA were remarkably higher in the study group. See **Figure 5**.

Comparison of SDRS scores

Before intervention, there were no significant differences in SDRS scores between the study and control groups. After intervention, the scores in both groups remarkably reduced, and they were remarkably lower in the study group. See **Figure 6**.

Comparison of nursing satisfaction after intervention

After intervention, the nursing satisfaction in the study group was 94.23%, which was remarkably higher than 81.25% in the control group. See **Table 3**.

Discussion

The eyes are extremely delicate and fragile organs in the human body, so slight or serious damage to them leads to adverse outcomes such as impaired vision and even loss of sight, which seriously affects patients' quality of life and can increase their economic burden [19].

As ophthalmic diseases become more diverse, ophthalmic surgery has become a common therapeutic method for treatment [20]. Whether the operated-on eyes of patients undergoing this surgery incur infection is crucial to determine the success or failure of surgery, the patients' postoperative recovery, and the postoperative quality of life, so it is essential to do a good job in preventing and controlling intraocular infection [21]. For effectively improving therapeutic effects and

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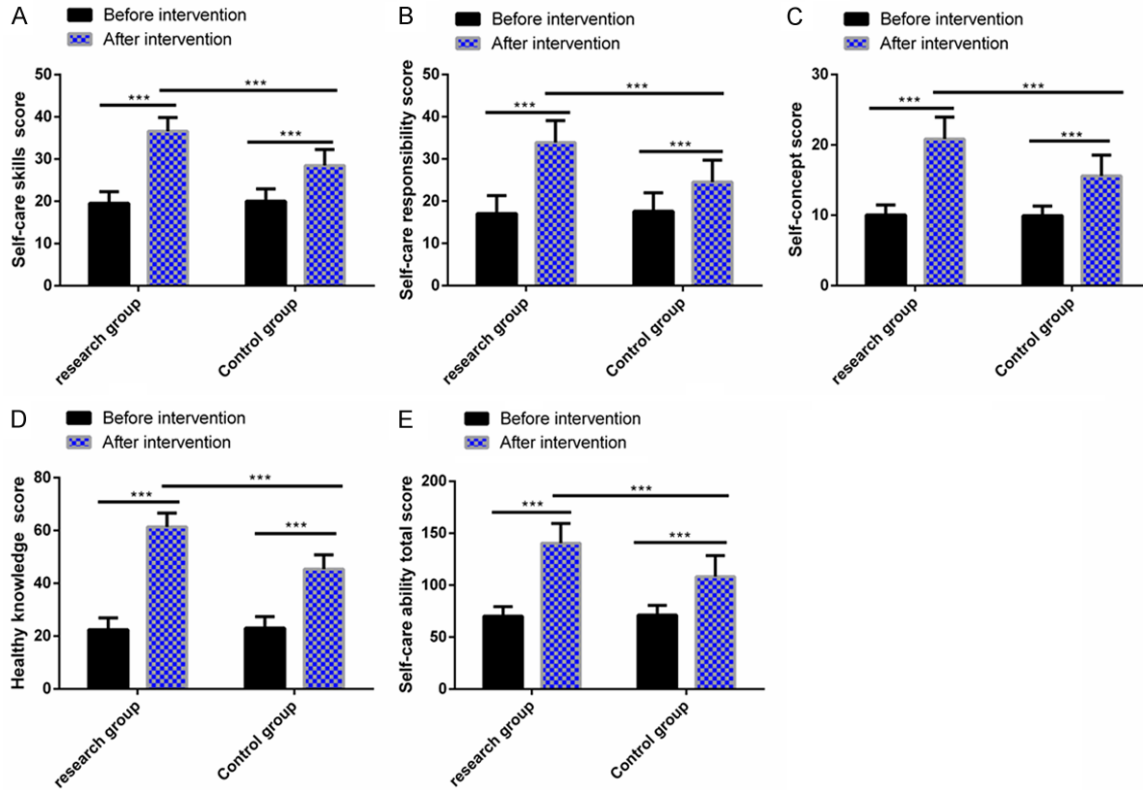


Figure 5. Comparison of scores of self-care abilities. A. Before intervention, the scores of self-care skills were not significantly different between the two groups. After intervention, the scores in both groups remarkably rose, and they were remarkably higher in the study group. B. Before intervention, the scores of sense of self-care responsibility were not significantly different between the two groups. After intervention, the scores in both groups remarkably rose, and they were remarkably higher in the study group. C. Before intervention, the scores of self-concept were not significantly different between the two groups. After intervention, the scores in both groups remarkably rose, and they were remarkably higher in the study group. D. Before intervention, the scores of knowledge and information seeking were not significantly different between the two groups. After intervention, the scores in both groups remarkably rose, and they were remarkably higher in the study group. E. Before intervention, the ESCA scores were not significantly different between the two groups. After intervention, the scores in both groups remarkably rose, and they were remarkably higher in the study group. Note: *** indicates $P < 0.001$.

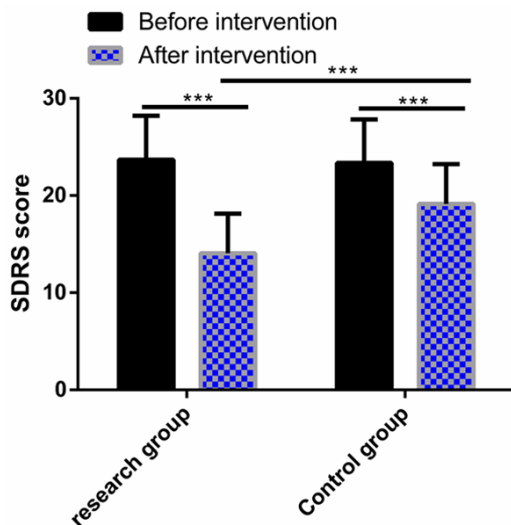


Figure 6. Comparison of SDRS scores. Before intervention, SDRS scores were not significantly different between the two groups. After intervention, the scores in both groups remarkably reduced, and they were remarkably lower in the study group. Note: *** indicates $P < 0.001$.

reducing adverse reactions such as intraocular infection, safe and effective nursing interventions need to be given to the patients, in addition to effective treatment [22]. In this study, patients undergoing ophthalmic surgery were given DPEM in nursing to investigate its effects on their POI and wound healing.

The clinical research on the prevention and nursing for infection after ophthalmic surgery

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Table 3. Comparison of nursing satisfaction after intervention [n (%)]

Items	Study group (n = 104)	Control group (n = 96)	χ^2 value	P value
Very satisfied	70 (67.31)	40 (41.67)	-	-
Satisfied	28 (26.92)	38 (39.58)	-	-
Dissatisfied	6 (5.77)	18 (18.75)	-	-
Nursing satisfaction	98 (94.23)	78 (81.25)	15.400	< 0.001

has been a hot spot. In a study by Song H et al., eye masks and bandage contact lenses were respectively used for protecting the operated-on eyes of patients undergoing cataract surgery; the two methods were not significantly different in preventing infection, but the latter one had higher nursing satisfaction and may replace the former [23]. According to Shi D N et al., after cataract surgery, compared with traditional eye pads, wearing therapeutic bandage contact lenses can improve the stability of the protective device, reduce postoperative discomfort, and promote the recovery of corneal incision [24]. As reported by a previous study, after glaucoma surgery, the nursing interventions of eye mask protection can remarkably prevent complications such as infection and eye injuries [25]. In our study, the ORR was remarkably higher in the study group and the indicators of postoperative recovery were remarkably better in this group. This suggests that DPEM nursing can improve therapeutic effects and promote postoperative wound healing, which is similar to the findings of Shi D N and others. The compliance, comfort, convenience, and fixation scores of using eye masks were remarkably better than those of traditional fixation covering with gauze, which shows that DPEM nursing is more acceptable to patients and more beneficial to their postoperative recovery. After intervention, IL-6 and CRP levels were remarkably lower in the study group but IL-10 levels were remarkably higher in this group, revealing that DPEM nursing can prevent infection and reduce the inflammatory response. This may be because this nursing model can better protect the operated-on eyes, prevent them from injuries, and avoid their direct contact with pollution sources, as well as reduce the risk of infection. Additionally, the masks are convenient to wear and use, which reduces eye damage and pollution during their use. According to Pellegrini M et al., systematic nursing intervention in cataract surgery can

remarkably reduce depression, effectively prevent infection, and decrease the release of inflammatory cytokines [26], which is similar to our research results. After intervention, the scores of each item in the ESCA were remarkably higher in the study group, which suggests that DPEM

nursing can obviously improve patients' self-care ability and contribute to their postoperative recovery. As reported by Ayaki M et al., there is a positive correlation between postoperative sleep disturbance and negative emotions in glaucoma patients after surgery [27]. After intervention, the SAS, SDS, and SDRS scores were remarkably lower in the study group. This indicates that DPEM nursing can remarkably relieve the patients' postoperative anxiety and depression and further improve their sleep quality, which is similar to the findings of Ayaki M and others. Compared with the traditional fixation covering with gauze, DPEM nursing can improve the patients' comfort, reduce their economic burden and allergic reactions, and relieve their negative emotions to a certain extent, as well as improve their sleep quality. In our study, the nursing satisfaction was remarkably higher in the study group, which reveals that the patients are more willing to accept nursing intervention with improved eye mask protection.

This study has confirmed that DPEM nursing can bring greater benefit to patients undergoing ophthalmic surgery, but there is still room for improvement. For instance, we can further enlarge the sample size of this study and conduct a multi-center and simultaneous research, so as to improve the reliability and effectiveness of the study. Moreover, we can analyze the risk factors that affect poor prognosis of patients, which will help medical staff pay special attention to the risk factors and then improve the therapeutic effects. Therefore, supplementary research will be gradually carried out from the above aspects in subsequent studies.

In summary, for patients undergoing ophthalmic surgery, in addition to improving therapeutic effects, promoting wound healing, and enhancing compliance and comfort, DPEM in nursing can also improve self-care abilities,

reduce POI and inflammatory responses, and relieve anxiety and depression, as well as improve sleep quality and nursing satisfaction.

Acknowledgements

This study is financially supported by Beijing Friendship Hospital Research Start Fund (Special nursing fund) Project Number: yyqdk2017-h13.

Disclosure of conflict of interest

None.

Address correspondence to: Xing Huang, International Medical Center, Beijing Friendship Hospital, Capital Medical University, 95th Yong'an Road, Xicheng District, Beijing 100050, China. Tel: +86-13426370847; E-mail: huangxing1952@163.com

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