










# Safety and Pitfalls of Blepharoptosis Surgery in Elderly People

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## Abstract

**Background** Elderly patients often have complications of blepharoptosis surgery that can result in the appearance or exacerbation of superficial punctate keratopathy (SPK). However, postoperative changes to SPK status have not been previously reported. We used subjective assessment of symptoms and measurement of SPK scale classification to investigate the safety and efficacy of blepharoptosis surgery in elderly patients.

**Methods** Included in this prospective study were 22 patients (44 eyes) with bilateral blepharoptosis that underwent surgery. Patients comprised 8 males and 14 females with a mean ( $\pm$ standard deviation) age of  $75.7 \pm 8.2$  years (range: 61–89). Blepharoptosis surgery consisted of transcutaneous levator advancement and blepharoplasty including resection of soft tissue (skin, subcutaneous tissue, and the orbicularis oculi muscle). Margin reflex distance-1 (MRD-1) measurement, a questionnaire survey of symptoms and SPK scale classification, was administered preoperatively and 3 months postoperatively for evaluation.

**Results** The median MRD-1 was 1 mm preoperatively and 2.5 mm postoperatively, representing a significant postoperative improvement. SPK area and density scores were found to increase when the MRD-1 increase was more than 2.5 mm with surgery. All 10 items on the questionnaire tended to have increased scores after surgery, and significant differences were observed in 7 items (poor visibility, ocular fatigue, heavy eyelid, foreign body sensation, difficulty in focusing, headaches, and stiff shoulders).

**Conclusion** Blepharoptosis surgery was found to be a safe and effective way to maintain the increase in MRD-1 within 2.0 mm. Despite the benefits, surgeons must nonetheless be aware that blepharoptosis surgery is a delicate procedure in elderly people.

## Keywords

- ▶ blepharoptosis
- ▶ elderly patients
- ▶ superficial punctate keratopathy
- ▶ margin reflex distance-1
- ▶ subjective symptoms

## Introduction

Blepharoptosis (BP) surgery is commonly performed in both young and elderly patients with the goal of broadening the visual fields.<sup>1–6</sup> The majority of BP surgery is performed for

dehiscence or stretching of the aponeurosis to the tarsus. It is achieved by nondelivery of contractile power to the upper eyelid, which requires resection of redundant skin and/or shortening of the levator aponeurosis.<sup>7,8</sup> However, when evaluating the surgical outcomes, most clinical surgeons

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that perform BP tend to focus on cosmetic improvements, such as upper-eyelid contour and left-right difference in the pretarsal show.<sup>5,9,10</sup>

BP surgery widens the visual field and cosmetic improvement can be obtained, but not all patients are satisfied postoperatively. Elderly patients can have functional problems after BP surgery that differ from younger patients, such as visual disturbance and dry eye symptoms.<sup>11,12</sup> Wider discussion of BP surgery is therefore needed, as various subjective symptoms in elderly patients require improvement.

Elderly patients are known to often have complications from BP surgery that can result in the appearance or exacerbation of superficial punctate keratopathy (SPK); however, there are no reported cases of pre- and postoperative changes in SPK status. This study, therefore, aims to investigate the safety and efficacy of BP surgery in elderly patients using subjective symptoms and measurement of SPK scale classification.

## Methods

Included in the study were the 22 patients (44 eyes) with bilateral BP surgery that underwent surgery at our hospital between April 2019 and February 2020. Patients comprised 8 males and 14 females with a mean ( $\pm$ standard deviation) age of  $75.7 \pm 8.2$  years (range: 61–89). Exclusion criteria were inability to answer the questionnaires and the inability to attend the 3-month follow-up visit. We also excluded patients with congenital, neurogenic, myogenic, and traumatic ptosis and those with history of glaucoma. Patients with neurogenic or myogenic ptosis were ruled out after consultation with members of our department of neurology. Informed consent was obtained from each patient before the start of the study. This study was approved by an appropriate institutional review board (approval number 2549), and performed in accordance with the tenets of the Declaration of Helsinki.

BP surgery always consisted of transcutaneous levator advancement, and blepharoplasty including resection of soft tissue (skin, subcutaneous tissue, and the orbicularis oculi muscle).<sup>1,13–15</sup> Intraoperative quantification in cases of transcutaneous levator advancement was conducted so that margin reflex distance-1 (MRD-1) was more than or equal to 4.0 mm while in the supine position. MRD-1 measurement, a questionnaire survey of symptoms, SPK grading, and BUT (tear breakup time test) value were taken pre- and 3 months postoperatively for evaluation.

### Margin Reflex Distance-1 Measurement

The upper eyelid height before and after surgery was assessed in primary position using MRD-1 value, defined as the distance between the central pupil reflex and the upper eyelid margin.<sup>16</sup>

#### 1. Questionnaire survey of symptoms

The degree of disability was scored on a Likert scale ranging from 1 to 5, with lower numbers indicating a greater burden. Patients answered a 10-item questionnaire on eye

symptoms including poor visibility, ocular fatigue, heavy eyelids, painful or sore eyes, dry sensation in the eyes, foreign body sensation, and difficulty in focusing and double vision, and it included accompanying symptoms, such as headaches and stiff shoulders.

#### 2. SPK scale

The presence of any corneal staining was documented as follows: after administration of fluorescein in the inferior fornix using a paper fluorescein strip (FLUORES Ocular Examination Test Paper 0.7 mg; Ayumi Pharmaceutical, Tokyo, Japan), the corneal epithelium and BUT were examined using a slit-lamp (RO-5000; Rodenstock, Munich, Germany). SPK was graded using the area and density of the lesion as parameters. Area and density were evaluated on a 4-point scale according to the method used by Miyata et al (0: none, 1: mild, 2: moderate, 3: severe).<sup>17</sup> After fluorescein staining, the total sum of the area of SPK was graded as A0 when there was no punctate staining, A1 when the area occupied less than one-third of the cornea, A2 when the area occupied between one- and two-thirds of the cornea, and A3 when the area occupied more than two-thirds of the cornea. The density was graded as D0 when there was no punctate staining, D1 when the density was sparse, D2 when the density was moderate, and D3 when the density was high or the lesions overlapped (**Fig. 1**).<sup>17</sup> We collaborated with an ophthalmologist regarding measurements and examinations. Since these assessments involve a subjective component, the co-authors, a plastic surgeon (K.U) and an ophthalmologist (H.I), carefully considered each case when determining the SPK scale.

### Statistical Analysis

Continuous variables were analyzed using the Mann-Whitney U test and Wilcoxon signed-rank sum test. A receiver operating characteristic curve was created, and the area under the curve was calculated. A *p*-value less than 0.05 was considered statistically significant. All

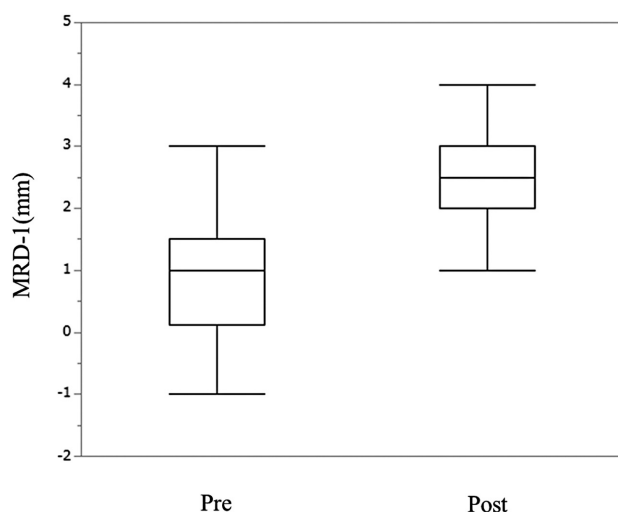
Area Density	A1	A2	A3
D1			
D2			
D3			

**Fig. 1** Superficial punctate keratopathy and density scale classification. Area and density were evaluated on a 4-point scale (none: 0, 1: mild, 2: moderate, 3: severe).

statistical analyses were done using JMP 14 software (SAS Institute Inc., Cary, NC).

### Results

1. **Change of MRD-1:** the median (interquartile range) MRD-1 was 1 mm (0.125–1.5) preoperatively and 2.5 mm<sup>2,3</sup> postoperatively, representing a significant postoperative improvement ( $p < 0.05$ , Wilcoxon signed-rank test) in ► **Fig. 2**.
2. **Evaluation by questionnaire survey:** all 10 items on the questionnaire tended to have increased scores after surgery, and significant differences were observed in 7 items (poor visibility, ocular fatigue, heavy eyelid, foreign body sensation, difficulty in focusing, headaches, and stiff shoulders (► **Table 1**).



**Fig. 2** Pre- and postoperative margin reflex distance-1 (MRD-1). The median MRD-1 was 1 mm (interquartile range: 0.125–1.5) preoperatively and 2.5 mm (interquartile range: 2–3) at 3 months postoperatively. Boxes indicate medians; error bars, upper and lower limits.

**Table 1** All ten items on the questionnaire tended to have increased scores after surgery, and significant differences were observed in seven items

Symptoms	Pre	Post
Poor visibility	2 (1–4)	5 <sup>a</sup> (4–5)
Ocular fatigue	2 (2–3)	4 <sup>a</sup> (3–4)
Heavy eyelid	2 (1–3)	4 <sup>a</sup> (3–5)
Painful or sore eyes	4 (4–5)	5 (3–5)
Dry sensation in eyes	3.5 (2–4)	4 (3–5)
Foreign body sensation	3 (2–4)	4 <sup>a</sup> (3–5)
Hard to focus	4 (2–5)	5 <sup>a</sup> (4–5)
Double vision	4 (3–5)	5 (4–5)
Headaches	4 (3–5)	5 <sup>a</sup> (4–5)
Stiff shoulders	3 (2–4)	4 <sup>a</sup> (3–5)

Abbreviations: Pre, preoperative; Post, postoperative at 3 months.  
<sup>a</sup> $p < 0.05$ .

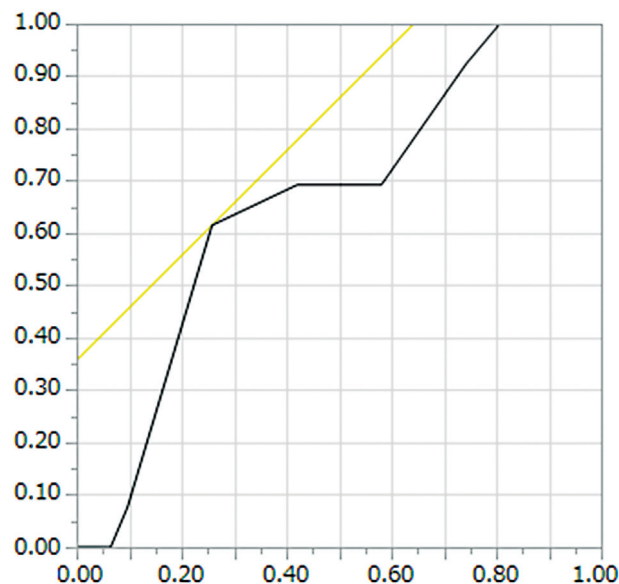
3. **Change of SPK scale:** the mean SPK area was  $0.25 \pm 0.44$  preoperatively and  $0.39 \pm 0.58$  postoperatively. The mean SPK density was  $0.32 \pm 0.6$  preoperatively and  $0.5 \pm 0.76$  postoperatively, representing a significant postoperative increase ( $p < 0.05$ , Wilcoxon signed-rank test) in ► **Table 2**.
4. **Cut-off of MRD-1 amount of change graded by SPK:**  $\Delta$ MRD-1 equal to 2.5 mm was the cutoff point to separate the SPK

**Table 2** The mean SPK area was  $0.25 \pm 0.44$  preoperatively and  $0.39 \pm 0.58$  postoperatively. The mean SPK density was  $0.32 \pm 0.6$  preoperatively and  $0.5 \pm 0.76$  postoperatively, representing a significant postoperative increase

	Pre	Post	p-Value
SPK area	$0.25 \pm 0.44$	$0.39 \pm 0.58$	0.0832
SPK density	$0.32 \pm 0.6$	$0.5 \pm 0.76$	0.0308

Abbreviations: Pre, preoperative; Post, postoperative at 3 months; SPK, superficial punctate keratopathy.

A comparison of the pre- and postoperative parameters. Values are presented as mean  $\pm$  standard deviation.  $p$ -Value determined Wilcoxon signed-rank test.



**Fig. 3** Receiver operating characteristic curve for the support tool to detect margin reflex distance-1 (MRD-1) with blepharoptosis surgery.  $\Delta$ MRD-1 equal to 2.5 mm was the cutoff point to determine whether superficial punctate keratopathy improve or unchanged group from the deterioration group, and its area under the curve was 0.6605.

**Table 3** SPK area and density significantly deteriorated in the group with  $\geq \Delta$ MRD 2.5 mm

$\Delta$ MRD-1	$\geq 2.5$ mm	$\leq 2.0$ mm	p-Value
$\Delta$ SPK area	0.38 (0.5)	0 (0.47)	0.0196
$\Delta$ SPK density	0.43 (0.51)	0.04 (0.51)	0.0183

Abbreviations: MRD-1, margin reflex distance-1; SPK, superficial punctate keratopathy.

The amount of change in SPK A and D was examined by dividing into groups with changes in MRD-1 of 2.5 mm or more and less than 2.5 mm.

- improvement/unchanged group from the deterioration group, and its area under the curve was 0.6605 (► Fig. 3).
5. Degree of exacerbation of SPK based on change in MRD-1: SPK area and density significantly deteriorated in the group with more than or equal to  $\Delta$ MRD 2.5 mm (► Table 3).
  6. Representative cases: case 1 was a 75-year-old Japanese woman. The preoperative MRD-1 was 1 mm, and the postoperative MRD-1 increased to 3.0 mm, an increase of 2.0 mm. SPK was not observed either preoperatively or postoperatively (► Fig. 4A–D).

Case 2 was a 73-year-old Japanese woman. The preoperative MRD-1 was 1 mm, and the postoperative MRD-1 increased to 3.5 mm, an increase of 2.5 mm. SPK was not observed preoperatively, but showed mild areas and density of SPK (A1D1) postoperatively (► Fig. 5A–D).

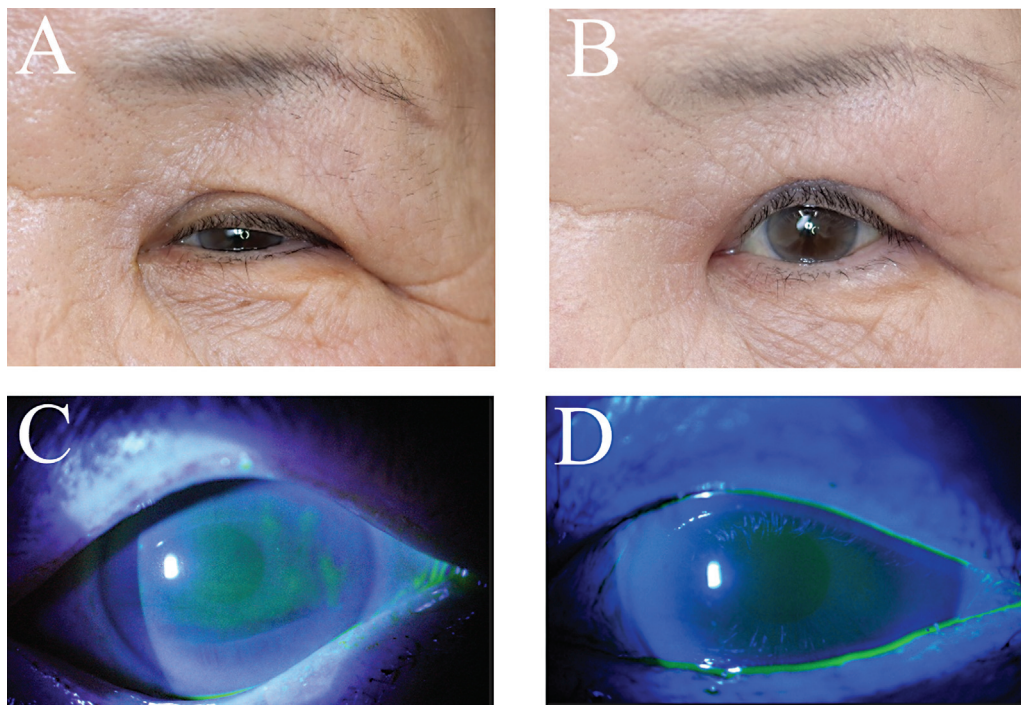
## Discussion

SPK is a petechial and multiple corneal epithelial defect.<sup>18</sup> It may indicate conditions that are more severe than SPK, such as corneal erosion and persistent epithelial defect. As SPK worsens, symptoms and discomfort related to the eyes are more likely to appear.<sup>19</sup> To our knowledge, this is the first study to report the pre- and postoperative changes in SPK in patients with BP in detail. SPK is known to mainly occur below the cornea after BP surgery. Asamura et al<sup>6</sup> reported that postoperative MRD-1 should be less than 3 mm because of the possible appearance of SPK due to BP surgery. In this

study, SPK area and density scores were found to increase when the MRD-1 increase was more than 2.5 mm with surgery. In other words, BP surgery was found to be a safe and effective way to keep the increase in MRD-1 within 2.0 mm, especially in elderly patients.

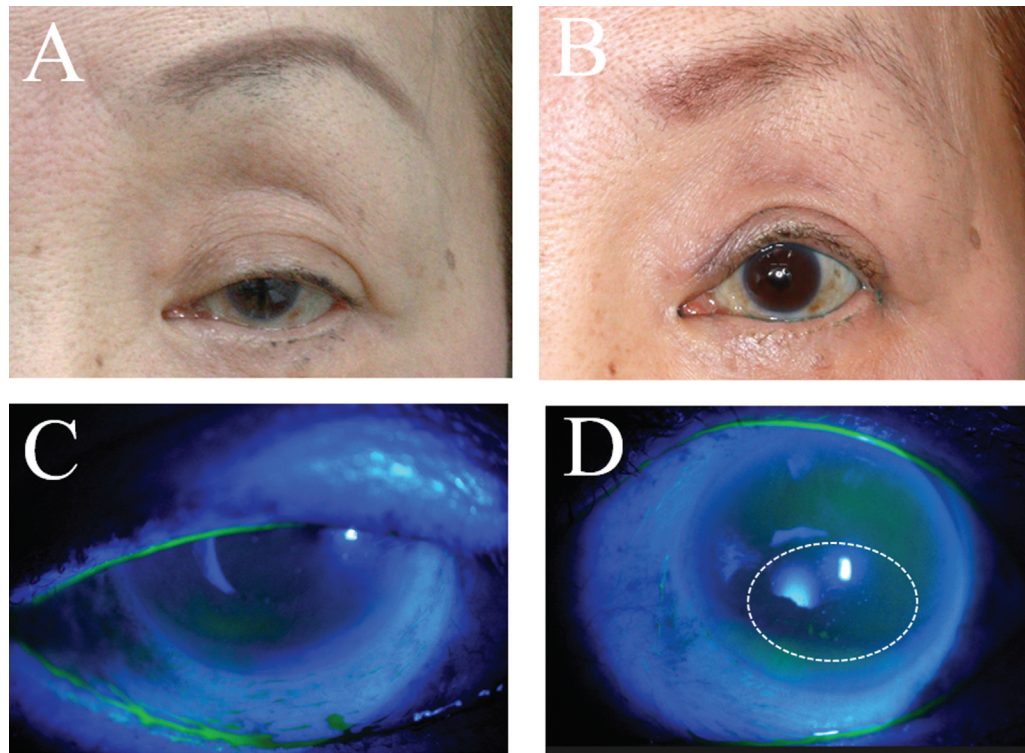
Some surgeons tend to believe that the more MRD-1 increases, the greater the expansion of the field of vision and the more satisfied the patient will be with the surgery. The upper eyelid opens and closes along the curvature of the eyeball, and the eyelid moves flexibly. Surgeons sometimes detect a loss of this flexibility after BP surgery, and the dry eye symptoms can be exacerbated due to decreased stability of the tear film and increased friction forces that exist during blinking. The condition for SPK worsens, resulting in patient complaints.<sup>3,6,20,21</sup> BP surgery in elderly people must therefore be considered to be a very delicate procedure. There have been no previous reports of a scale evaluation method for SPK by surgery. SPK scale classification is based on area and density. A scale evaluation method for SPK reported by Miyata et al<sup>17</sup> was used in this study, and the area and density of SPK were evaluated in the groups with postoperative MRD-1 of more than 2.5 mm or less than 2 mm (► Table 3). Increase in MRD-1 more than 2.5 mm is suggested to be associated with the risk of worsening condition for SPK (► Fig. 3 and ► Table 3).

According to Japanese guidelines, the surgical indication for BP is MRD-1 less than or equal to 2 mm. When the MRD value is 2 mm, the upper field of view corresponds to 35 degrees, 1 mm corresponds to 30 degrees, and 0 mm



**Fig. 4** Case 1 was a 75-year-old Japanese woman. The preoperative margin reflex distance-1 (MRD-1) was 1 mm, and the postoperative MRD-1 increased to 3.0 mm, an increase of 2.0 mm (A, B). Superficial punctate keratopathy (SPK) was not observed either preoperatively or postoperatively (C, D). Case 2 was a 73-year-old Japanese woman. The preoperative MRD-1 was 1 mm, and the postoperative MRD-1 increased to 3.5 mm, an increase of 2.5 mm (A, B). SPK was not observed preoperatively, but showed mild areas and density of SPK (A1D1) postoperatively (C, D).





**Fig. 5** Case 2 was a 73-year-old Japanese woman. The preoperative MRD-1 was 1 mm, and the postoperative MRD-1 increased to 3.5 mm, an increase of 2.5 mm (A, B). SPK was not observed preoperatively, but showed mild areas and density of SPK (A1D1) postoperatively (C, D).

corresponds to 20 degrees. The upper field of view required in daily life is set to 30 degrees, and related inconvenience tends to begin to be reported when MRD-1 value is around 1 mm.<sup>10,22</sup> Guillon et al<sup>23</sup> also reported that the pupils become smaller as an individual gets older, but stated that the diameter of the pupils at 55 years and older is approximately 3.5 mm. According to Telek et al,<sup>24</sup> the pupils become smaller as an individual gets older, and the diameter of the pupils at 60 years and older is approximately 3 mm. Elsewhere, Murchison et al<sup>25</sup> reported the average MRD-1 in a cohort of Caucasian individuals with an average age as 2.7 mm. Additionally, the function of the meibomian glands begins to decline around age 50, and approximately 70% of Japanese over age 60 develop dry eye symptoms.<sup>26,27</sup> Based on these reports, a position where the upper eyelid margin does not interfere with the pupil, as in the patients in this study, a postoperative MRD-1 of around 2.5 mm seems appropriate for BP surgery in elderly patients. The primary surgical purpose of BP surgery is to widen the visual field by upward displacement of the upper eyelid margin (► Fig. 1).

Unlike other fields of medicine that use morbidity and mortality rates as the basis for evaluation, improvement in various eye-related symptoms, such as those seen in these cases, is an important factor in the field of plastic surgery. Previous reports concluded that BP surgery provides significant improvement in vision, peripheral vision, and quality-of-life activities.<sup>9,28</sup> In this survey, there was significant improvement in many symptoms: poor visibility, ocular fatigue, heavy eyelid, foreign body sensation, difficulty in focusing, and also accompanying symptoms of headaches and stiff shoulders,

concomitant symptoms of conditions requiring BP surgery.<sup>9,28</sup> In other words, BP surgery has resulted in marked improvement in many aspects of patients' subjective dry eye symptoms and health-related quality of life.

This evaluation method for SPK should also be helpful in various situations, such as when performing evaluation of the ocular surface for various types of oculoplastic surgery (e.g., entropion), when describing the time course of changes in SPK area and density. A major limitation of this study is that it only evaluated those who received postoperative SPK at 3 months, although it is possible that they may improve after 1 year.<sup>29–31</sup> BP surgery in elderly people is expected to continue to increase in the current hyper-aged society. Despite the benefits, surgeons must nonetheless be aware that BP surgery is a delicate procedure, especially in elderly people and is found to be a safe and effective way to maintain the increase in MRD-1 within 2.0 mm.

#### Authors' Contributions

Design and conceptualization of the study: Y.S., S.S., and S.A.

Study conduction: Y.S., K.U., K.U., and H.I.

Clinical databases: Y.S., K.U., S.K., and K.U.

Formal analysis: Y.S., K.U., S.K., and H.I.

Writing original draft: Y.S., K.U., and S.K.

Writing-review & editing: S.K., S.S., and S.A.

#### Ethical Approval

The study was approved by an appropriate institutional review board of Wakayama Medical University (approval

number: 2549), and performed in accordance with the tenets of the Declaration of Helsinki.

#### Patient Consent

The patients' legal guardian provided written informed consent for the publication and the use of the patients' images.

#### Conflict of Interest

None declared.

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