

Transconjunctival Müller's muscle Tucking Method for Non-incisional Correction of Mild Ptosis: The Effectiveness and Maintenance



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Abstract

Background In patients with a mild degree ptosis who undergo non-incisional double-eyelid blepharoplasty, simultaneous correction of ptosis is needed to prevent loosening. The transconjunctival Müller's muscle tucking (TMMT) method may be useful in these cases.

Objectives The authors performed this study to present the details of the current use of the TMMT method and to provide objective evidence for ptosis correction and its sustained effect.

Methods A total of 322 eyelids in 161 patients who underwent mild ptosis correction with the TMMT method from July 2012 to December 2017 were retrospectively examined. The continuous suture method using a single stitch was used for double-fold formation, and the TMMT method was used for ptosis correction for the other incision. The margin to reflex distance (MRD) 1 was evaluated at pre-operation, immediate post-operation, and at 2, 6 months post-operation.

Results A total of 34 patients who had more than 6 months of follow-up were included. Right-side MRD1 values were 2.08 (\pm 0.19) mm before the surgery, 3.49 (\pm 0.16) mm

immediately after the surgery, 3.33 (\pm 0.14) mm at post-operative 2 months, and 3.22 (\pm 0.17) mm at postoperative 6 months ($p < 0.001$). The difference of MRD1 between immediate post-operation and at 6 months was 0.25 mm without statistical significance ($p > 0.05$). Complications (fold loosening, asymmetry, and ptosis recurrence) occurred in three cases (8.8%), all of which were re-corrected by applying the TMMT method.

Conclusions The TMMT method was useful for correction of mild ptosis, showed little recurrence, and prevented loss of fold by giving a vertical force to the double-fold.

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Keywords Müller's muscle · Tucking · Blepharoplasty · Ptosis

Introductions

Double-eyelid blepharoplasty (DEB) is one of the most common aesthetic surgeries in Asians. DEB is generally performed by using either incisional or non-incisional methods. Many non-incisional methods have been developed [1–4], which are carried out more frequently because they leave fewer scars, are technically easier, easy to revise, and lead to faster recovery [3]. In contrast, incision methods have been less favored in patients who want to avoid extended recovery periods and scarring, and those who want quick and uncomplicated surgery.

However, non-incision methods may be vulnerable to loosening, leading to double-fold or asymmetry over time;

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moreover, the risk of such complications is increased if a minimal or mild degree of ptosis is present simultaneously. To prevent this, performing double-eyelid surgery while simultaneously correcting ptosis can be helpful. In principle, ptosis correction includes operating on the levator palpebral superioris (LPS) muscle, whose primary function is opening the eyes. Because operations on the LPS are mainly done through the incisional anterior approach, it is difficult to apply the non-incisional method in this case. However, mild ptosis can be easily solved by only manipulating the Müller's muscle that is a secondary eye-opener [5, 6].

Putterman et al. [6] proposed the conjunctival resection method for the Müller's muscle as a way to correct mild ptosis without a need for a procedure for the LPS. The modified Müller's muscle conjunctival resection technique was introduced by Guyuron et al. in 1998 [7] and has proven to be effective in the long-term as well [8]. However, this method is limited when revisional surgery is required to correct asymmetry or overcorrection because it is difficult to return to the state before the surgery [9]. In 2010, Shimizu et al. [10] introduced the transconjunctival Müller's muscle tucking (TMMT) technique as a non-incisional method for application in mild ptosis. The TMMT method is currently widely used in East Asian countries including Korea, and several similar methods have been introduced as well [11, 12]. However, the appropriate amount of tucking and correction has not been established yet. There is also a lack of data on the effectiveness of the TMMT method, as well as evidence of correction maintenance during follow-up. The authors performed this study to present the details of the current use of the TMMT method and to provide objective evidence for ptosis correction and its sustained effect.

Materials and Methods

Patients

Medical records on 322 eyelids in 161 patients who underwent mild ptosis correction using the TMMT method from July 2012 to December 2017 were examined in a retrospective manner. We enrolled 34 patients who had more than 6 months of follow-up data.

Patient Selection (Surgical Indication)

Inclusion criteria were 15–40 years of age, and those with mild ptosis who had preoperative MRD1 of more than 2.0 mm and fair levator function of more than 10 mm by Berke's method [13]. Müller's muscle response was confirmed by 1% phenylephrine test, and surgery was

performed only when the patient had proper response to the test. If MRD1 had increased by more than 1 mm at 5 min after instilling the phenylephrine into the cul-de-sac of the superior fornix, it was determined to be effective. Patients without phenylephrine response were excluded, and different surgical methods were applied to them.

Surgical Technique

Surgeons were preoperatively made aware of the status of the eyelid regarding the levator function, ptosis grade, presence of asymmetry, sunken state, and site of ptosis correction. Preoperative design for the double-eyelid line was made while the patient was in a sitting position. With the patient in the supine position, five-to-six small slits for suture burial were marked along the double-eyelid line, which was designated to the predetermined height. The transverse lines were marked 2 mm around the medial and lateral limbus level and 1 mm below the double-eyelid design (Fig. 1). These procedures were modified as needed according to each patient's eyelid shape.

The procedure was carried out under local anesthesia induced by injection of 2% lidocaine with 1:100,000 epinephrine along the designated line. The incision was started on the skin side that had been previously marked. A single-knot continuous procedure was performed from the lateral to the medial side and made finishes on both sides of the double eyelid according to the preoperative design (Fig. 2). The number of loops varied depending on the thickness and laxity of the skin. Subsequently, to correct the ptosis, a

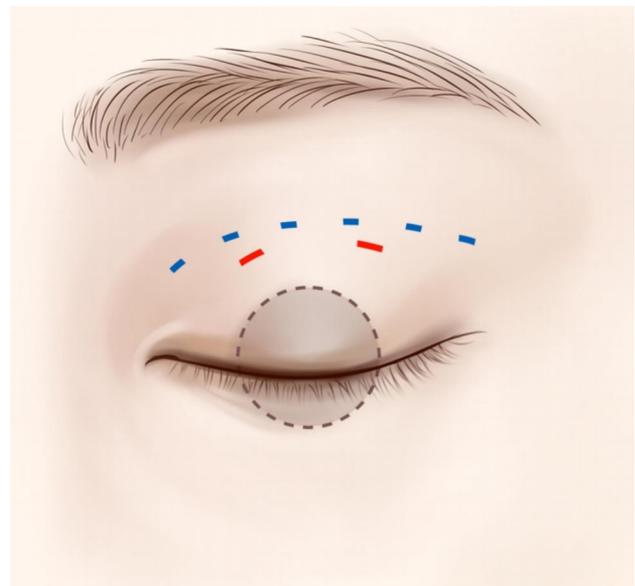


Fig. 1 Preoperative design: The six vertical lines for suture burial were marked for the double-eyelid line. The transverse line was marked 2 mm long on the medial and lateral limbus level 1 mm below the double-eyelid marking for Müller's muscle tucking

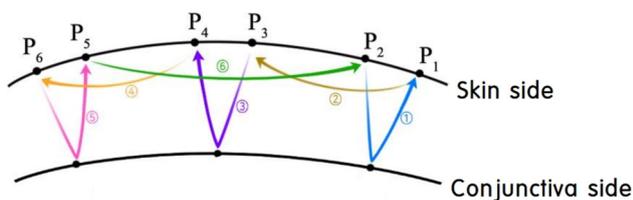
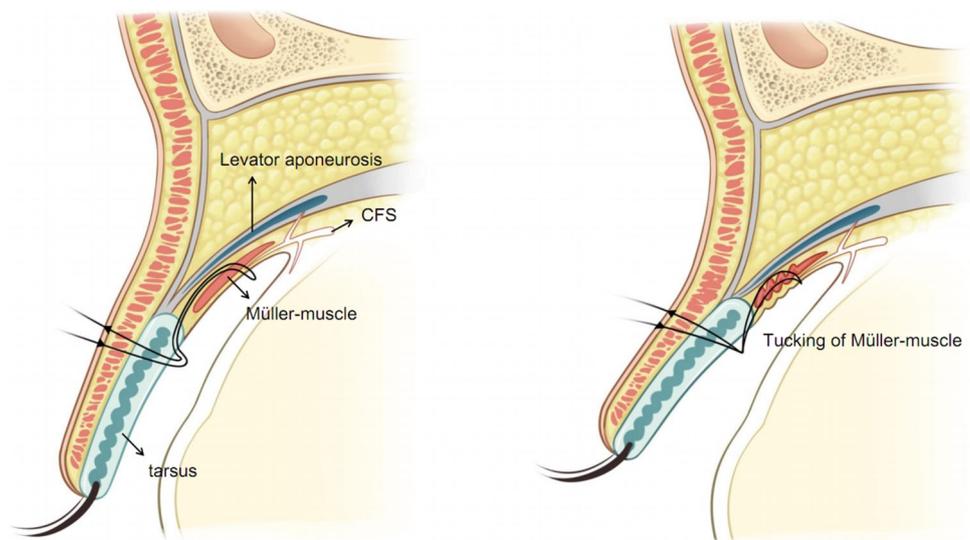


Fig. 2 Procedure for double-eyelid blepharoplasty (horizontal cross-sectional view of upper eyelid). A single-knot continuous procedure was performed from the lateral to the medial side and made finishes on both sides of the double eyelid according to the preoperative design

2 mm incision was made on the vertical level around the medial limbus and lateral limbus, which had been designated just below the double-eyelid line.

On the conjunctival side, additional local anesthetic solution (0.2 cc) not containing epinephrine was injected to avoid activating the sympathetically innervated Müller's muscle [14], followed by 5-0 nylon or black silk with tagging suture on the upper border of the tarsus on the side of the conjunctiva. Through the incision line on the medial limbus level, 7-0 nylon was passed through the tarsus just below the double-eyelid line from the skin side to the conjunctiva, passed through the muscle and conjunctiva, and crossed back from that point to the tarsus (Fig. 3). The tucking amount was 7 to 8 mm for 1 mm ptosis correction. The point back to the tarsus after tucking was located 2–3 mm apart from the previous point and penetrated the skin side again. A strong tie that would not break the thread was performed, and the degree of ptosis correction and eye shape were checked. Another tucking of the same amount was performed through the other remaining slit incision on the lateral limbus level of the same eye. The procedure was performed for the other eye in the same manner.

Fig. 3 Transconjunctival Müller's muscle tucking. 7-0 nylon was passed through the tarsus just below the double-eyelid line from the skin side to the conjunctiva, passed the muscle and conjunctiva, and crossed back from that point to the tarsus



Analysis of Margin to Reflex Distance (MRD) 1

The margin to reflex distance (MRD) 1 was assessed at 2 months and 6 months post-operation. Patients were seated for photography, and the distance between the reflex of the patient's cornea and the upper eyelid margins was measured using Adobe Photoshop CS5 Portable (San Jose, CA, USA).

Statistical Analysis

Data were analyzed using SPSS software version 21.0 (SPSS, Chicago, IL, USA) and presented as mean \pm standard deviation. Analysis of variance (ANOVA) for repeated measures analysis was used to compare the pattern of changes in MRD1 during follow-up. Bonferroni post hoc analysis was performed to compare the changes of variables between the two eyes at each time point.

Results

A total of 34 patients with sufficient follow-up data were identified. Their mean age was 25 years (range: 17–37), and the average follow-up period was 11.5 months (range: 6–18 months). Results were satisfactory and ptosis corrections were well maintained (Figs. 4, 5, 6, 7). According to the analysis of the change of MRD1 (Fig. 8), the right side was 2.08 (\pm 0.19) mm before surgery, 3.49 (\pm 0.16) mm immediately after surgery, 3.33 (\pm 0.14) mm at postoperative 2 months, and 3.22 (\pm 0.17) mm at postoperative 6 months ($p < 0.001$). The difference was 0.25 mm between immediately and 6 months post-operation, albeit without statistical significance ($p > 0.05$). The left-side MRD1 was 2.29 (\pm 0.17) mm before surgery, 3.58



Fig. 4 Clinical result of a 26-year-old female patient: (above) preoperative view and (below) postoperative view at 6-month follow-up



Fig. 5 Clinical result of a 23-year-old female patient: (above) preoperative view and (below) postoperative view at 3-month follow-up

(± 0.15) mm immediately after surgery, $3.46 (\pm 0.21)$ mm at postoperative 2 months, and $3.29 (\pm 0.12)$ mm at postoperative 6 months ($p < 0.001$). The difference was 0.29 mm between immediately and 6 months post-operation, albeit without statistical significance ($p > 0.05$).

Complications occurred in three cases (8.8%), which included fold loosening, asymmetry, and ptosis recurrence. All of them were found within 1 month of the surgery and were regarded as early complications. Temporary foreign body sensation or discomfort occurred until postoperative day 1 or 2 in 12 cases (35%), after which the sensation disappeared. There were no late complications after 1 month following the operation. All complications



Fig. 6 Clinical result of a 21-year-old female patient: (above) preoperative view and (below) postoperative view at 6-month follow-up



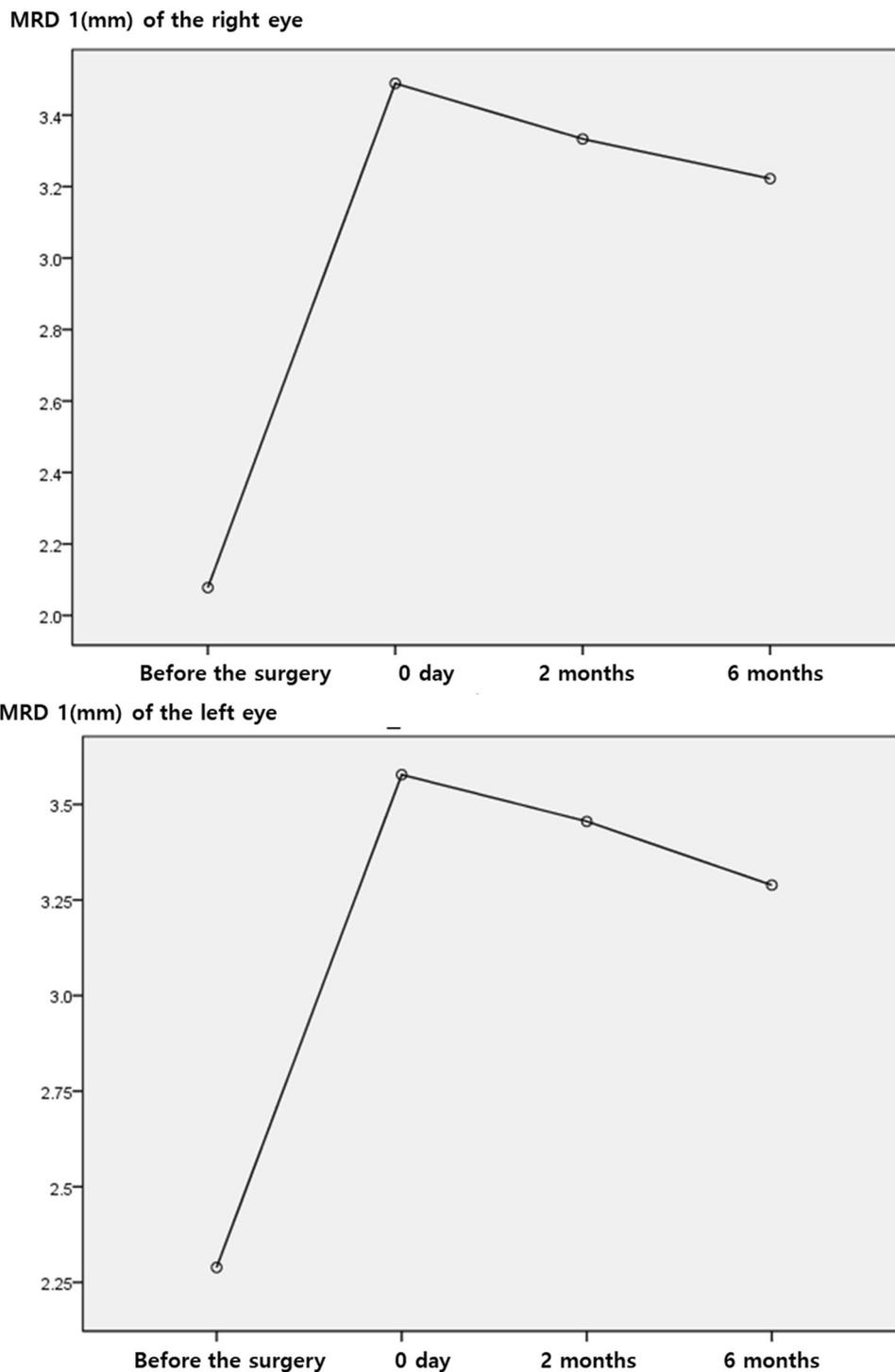
Fig. 7 Clinical result of a 28-year-old male patient: (above) preoperative view and (below) postoperative view at 6-month follow-up

regarding loosening, asymmetry, and ptosis recurrence were re-corrected by applying the TMMT method.

Discussion

Several surgical methods have been recently introduced for non-incisional ptosis correction with simultaneous non-incisional double-eyelid surgery [10–12]. Although these methods are simple and have short operative times, there is still doubt regarding how well ptosis correction is maintained during long-term follow-up. According to our results, during a period of more than 6 months, MRD1

Fig. 8 Changes in MRD1 following surgery. Both sides were improved and well maintained after surgery



post-operation was significantly increased compared to that of the preoperative period, and surgical results were well maintained. To the best of our knowledge, this is the first study that objectively analyzed the relationship between the tucking amount and lid elevation and its maintenance after performing the TMMT method.

The TMMT method is not only easy to learn and simple, but it is helpful for compensating the shortcomings of non-incisional double-eyelid surgery. The most notable problem of non-incisional surgery is loosening of the double-eyelid line. The non-incision method is a process that induces adhesion after passing the thread through only the slit. Therefore, the possibility of loosening remains even

though after the surgery because the adhesion portion is weaker than the incision method and the thread tension also weakens over time. However, if the skin of the eyelid is invaginated through the action of levator excursion, the adhesion could become more pronounced along the line. Mild ptosis or subclinical ptosis is often seen in common Asian eyelids, so these kinds of procedures are required to avoid the loosening. According to our results, except for one patient, folds were not weakened in our patients. In addition, posterior lamella shortening results in an increase in the volume of the middle lamella due to the indirect effect of levator aponeurosis plication, resulting in mild sunken eyelid correction [5, 15, 16]. Furthermore, we think that it would be interesting to compare ptosis recurrence between patients who underwent double-eyelid blepharoplasty and those who did not, but such analysis could not be performed due to the small number of patients. In patients who do not undergo double-eyelid blepharoplasty, there is a risk of recurrence because of the need for tucking.

Previous reports have shown that 4–8 mm resection results in 1 mm ptosis correction; [6, 17, 18]; however, for Müller tucking, the amount of ptosis correction is yet to be precisely quantified. As the TMMT method does not remove Müller-conjunctiva and the tarsus, more tucking amount is needed than the classic resection method. In our results, 1.0–1.2-mm lid elevation was acquired by 7–8 mm tucking. In addition, the authors have also considered anatomical characteristics of Asians. There are many obstacles interfering with the transmission of the power to the tarsus because Asian eyelids tend to have thicker skin, more preaponeurotic fat, and weaker levator function [19, 20]. Consequently, the average amount of MRD1 is also different among races. The average amount of MRD1 of Asian is approximately 3.8 mm compared with 4.5–5.0 mm in Caucasian or African populations [21]. Therefore, if an Asian has more than 2 mm MRD1, it means there was a reduction less than 1.8 mm from the average MRD1, which corresponds to mild ptosis. To objectively grade ptosis, both the amount of levator excursion and MRD1 value should be considered, especially in Asians. As a result, reports have shown that the rate of resection for ptosis correction was greater for Asians than Caucasians [5, 7, 17].

There are also controversies on how much tucking can be done. According to Jutley et al. [22], the length from the upper eyelid margin to the fornix was 15.6 mm in Caucasians and shorter in Asians, meaning that there is a limit to the amount that can be corrected by the TMMT method. According to our experience, ptosis correction of about 2 mm may be the maximal possible amount. Shimizu et al. used needle penetration to the superior fornix to correct the maximal amount of ptosis [10], but reported that it may result in ectropion or an excessively deep fold due to the

discrepancy between the redundant anterior lamella and shortened posterior lamella. In addition, conjoined fascia sheath (CFS) might be involved when surgeons try to go to the fornix level. Although CFS is a useful structure in severe ptosis [23], there is a limit for accurately transmitting the force to the tarsus when only using the TMMT methods. The authors think that if the CFS cannot be used efficiently and effectively through the posterior approach, it is better to leave it without scarring for a possible secondary surgery rather than pulling it forcefully.

Another small incision 1 mm was placed below the double-eyelid line because different strengths are required for each double eyelid and Müller tucking. When the tie is made above the double-eyelid line, the double eyelids may be loosened; if the same line is used, the double eyelids may overlap with the tucking area and create an unintentional deep fold line. Even if asymmetry or loosening occurs, our incision would be more effective for correcting the problems. Another thing to note is that our method uses several knots, which may have higher risk of suture-induced granuloma or infection than do single ties used in other methods [24]. To prevent this, special care should be taken to avoid exposure of the knot to the skin. By separating the orbicularis oculi muscle, knots should be positioned deep and far from the skin.

When performing the procedure for the Müller's muscle, careful consideration should be given to obtain a favorable result. Before the surgery, we checked the response of the Müller's muscle with a 1% phenylephrine test [6, 25], and in cases in which the test failed, the patients were excluded from the TMMT procedure. Jang SY et al. [5] utilized the preoperative phenylephrine test to estimate the results of unilateral ptosis cases; because the authors made a set of tight indications, most of the patients included in this study were able to obtain good results. The lack of response to the test indicates that the Müller's muscle is not functioning or scarred due to previous operation; in such cases, ptosis correction should not be carried out in an ineffective manner, such as by tucking a large amount of it by force. The Müller's muscle may respond exceptionally in moderate-to-severe ptosis, but it is difficult to achieve the desired ptosis correction amount simply by tucking in these patients. Shimizu et al. [10] reported that 25% of their cases experienced recurrence in the form of loosening, which may be due to the fact that patients with moderate ptosis were included. Based on our experience, we recommend not applying this method to unfavorable patients such as those with congenital ptosis, ptosis higher than moderate degrees, severe asymmetry, small eye, and secondary blepharoplasty—these traits hinder accurate estimation of surgery results and matching with the preoperative planning.

Injection of epinephrine to the posterior conjunctival side for anesthesia should be carried out with care. Epinephrine, which is usually mixed with lidocaine to reduce bleeding, may activate the sympathetically innervated Müller's muscle and result in transient eyelid retraction if it is diffused to the posterior conjunctival side [14]. Therefore, care should be taken to avoid under-correction, which may complicate the tucking amount during surgery. In this regard, using lidocaine without epinephrine may be better for the sake of accurate measurement during surgery.

In the present study, there was a decrease in MRD1 of about 0.2 mm at 6 months post-operation. This may be due to the fact that epinephrine-mixed lidocaine from the skin side affected the Müller's muscle and the possible cheese-wiring effect due to the natural characteristics of the thread. However, as the authors have shown, the TMMT method was well maintained for at least 6 months, considering that the amount of 0.2 mm MRD1 is scanty and thus not easily recognized. We think that the conjunctiva was remodeled by scarring after Müller tucking, which may be made certain if histopathological assays are carried out.

Our study has the following limitations. First, the study may be subject to selection bias because it has a retrospective design and only the patients with at least 6 months of follow-up were included. Second, the number of patients is small, and the duration of the follow-up period is relatively short. However, patients from the authors' country often discontinue their visits after aesthetic surgery especially for simple eyelid surgery, thus making a long-term follow-up study difficult.

Conclusion

Our results show that the TMMT method is simple, non-invasive, and easier to revise compared with Müller's muscle conjunctival resection. The authors conclude that the TMMT method is useful for correction of mild ptosis, and that it also helps prevent the loss of fold by giving a vertical force to the double-fold. The TMMT method may replace incision methods in patients with mild ptosis.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest to disclose and no financial support.

Ethical Approval This study was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent All patients provided written informed consent prior to enrollment.

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