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Brow Ptosis after Temporal Artery Biopsy

Incidence and Associations

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Objective: Temporal artery biopsy (TAB), performed for the diagnosis of giant cell arteritis, has a low reported rate of complications. One complication is damage to the facial nerve branches, which can result in brow ptosis and/or orbicularis oculi weakness. However, the incidence of facial nerve damage after TAB is unknown.

Design: Prospective, institutional review board–approved study of all TABs performed by 2 surgeons over a 17-month period.

Participants: Seventy patients undergoing 77 TABs.

Methods: Demographic data, including age, gender, and race/ethnicity, were collected for all patients. Frontalis and orbicularis oculi muscle function were evaluated pre- and postoperatively in all patients. The use of blood thinners, location of the incision, length of incision and biopsy, biopsy results, and procedure difficulty were recorded. Incidence of postoperative facial nerve damage, other complications, and rates of facial nerve recovery were evaluated. Analysis of variables was performed for any potential correlation with facial nerve damage.

Main Outcome Measures: Incidence of facial nerve damage.

Results: Analysis included 75 biopsies performed in 68 patients. The majority of the patients were white (75.0%) and female (67.6%). The mean age was 72.6 years (range, 51–96). Postoperative facial nerve damage was found in 12 patients (16.0%) and 58.3% of these fully resolved at an average of 4.43 months (range, 1–6). Two patients (2.7%) had postoperative infections. There was no correlation with facial nerve damage and use of blood thinners, biopsy result, surgeon, procedure difficulty, incision length, or specimen length. The distance from the incision to both the orbital rim and the brow was significant: Incisions farther from the orbital rim and brow were less likely to have postoperative facial nerve damage.

Conclusions: There is a 16.0% incidence of postoperative facial nerve damage with TABs, which recovers fully in over half of patients. Incisions closer to the orbital rim and brow were more likely to have postoperative facial nerve dysfunction. Incisions >35 mm from both the orbital rim and brow or above the brow were less likely to have postoperative brow ptosis.

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Temporal artery biopsy (TAB) is used in the diagnosis of giant cell arteritis (GCA), a systemic vasculitis with potential for severe, permanent vision loss. For this diagnosis, TAB is considered the gold standard and, generally, a low-risk procedure. The majority of reported complications are relatively minor, such as hematoma formation, scarring, infection, and wound dehiscence.[1–4] The most concerning report of a complication is that of a cerebrovascular accident after biopsy, but given the ubiquity of TAB, this seems to be an extremely rare event.[4] There are few reports of facial nerve injury with biopsy, despite the anatomic proximity of the frontal branch of the facial nerve to the superficial temporal artery (STA).[5–8] There are no data on the incidence of facial nerve injury after TAB or factors that correlate with this complication.

Materials and Methods

A prospective study of all TABs performed by 2 surgeons over 17 months was conducted after institutional review board approval. All patients were referred by a neuroophthalmologist for histologic examination of possible GCA. All surgery was carried out in a standard fashion, as described, with the addition of measurements of the location of the incision, length of the incision and biopsy, and difficulty of the procedure. Demographic data were collected, including patient age, gender, self-reported race/ethnicity, and use of blood thinners. No patient had anticoagulant or antiplatelet medication(s) stopped or altered before the procedure. Side of the biopsy, result of biopsy, and surgeon performing procedure were also noted. The position of the brows as well as frontalis and orbicularis oculi muscle function were measured and recorded in the preoperative holding area.

All procedures were performed using local anesthetic infiltration containing epinephrine with intravenous sedation in an ambulatory surgical setting. A "safety line" was drawn connecting the tragus to a point 2.0 cm from the most lateral brow cilia.[9,10] The distance from this "safety line" to the lateral orbital rim at the level of the lateral canthus was recorded. The location of this line did not influence the incision site. The course of the STA was mapped out with Doppler ultrasonography in all cases, and the area of strongest Doppler signal was marked with a pen. A skin incision was made directly over the premarked STA course with a #15 Bard Parker blade and dissection through the dermis was carried out with blunt-tipped

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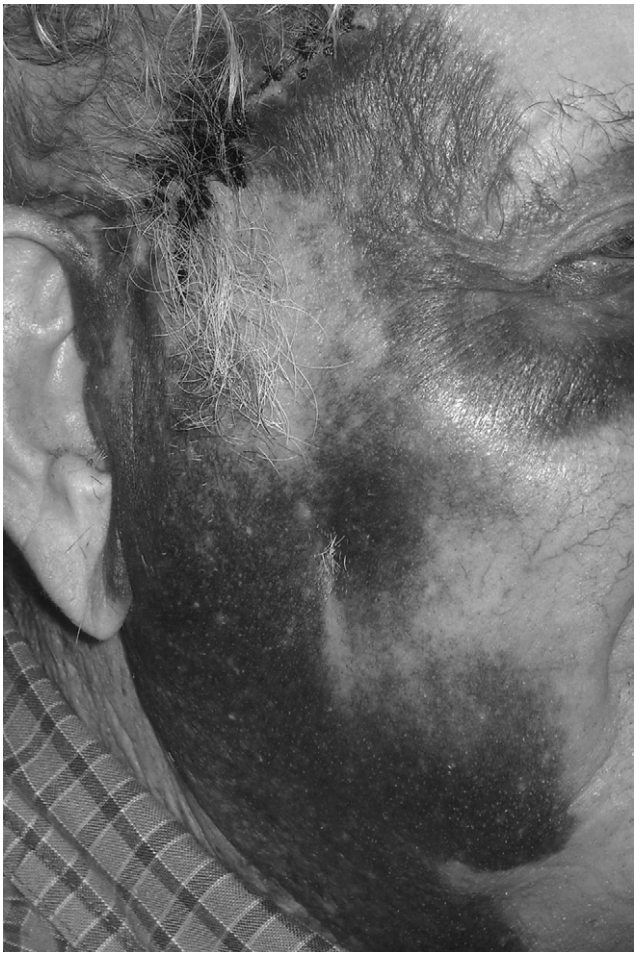

Figure 1. Postoperative photo of patient with "significant" ecchymosis after temporal artery biopsy. Note ecchymosis extends well below malar eminence.

Westcott scissors. The length of the incision was recorded. The distances of the incision from the orbital rim at the level of the lateral canthus and from the lateral brow were measured with a ruler to the nearest millimeter and recorded. Blunt-tipped retractors were used to expose the superficial temporal fascia. The STA was visualized using blunt dissection with a curved hemostat and surrounding soft tissue was cleared for a length of ≥2 cm parallel to the vessel to avoid inadvertent injury to the STA. Care was taken to avoid dissection deep to the superficial temporal fascia. We used 4-0 silk ties for ligation of the vessel and bipolar cautery was used as needed for hemostasis. All wounds were closed using absorbable suture in a running vertical mattress fashion and adhesive strips were placed perpendicular to the incision. Antibiotic ointment was applied. No additional dressing was used.

Biopsy length was recorded ex vivo before fixation. The surgeon also noted the perceived difficulty of the procedure as "difficult" or "easy," the amount of bleeding as "normal" or "above normal," and whether the TAB seemed positive or negative for GCA by gross examination.

In addition to neuroophthalmologic follow-up, all patients were seen by the surgeon 7 to 10 days after their procedure. The incision was examined and the amount of ecchymosis recorded. Ecchymosis was considered extensive if it extended below the level of the malar eminence (Fig 1). The position of the brows, both at rest and with frontalis activation, was noted. Frontalis activity was noted as absent, partial, or full. Orbicularis oculi function was recorded in an identical fashion. Further follow-up with the surgeon was scheduled at regular intervals (4–6 weeks, 3 and 6 months, and 1 year) if any incisional problems were noted or if frontalis or orbicularis oculi dysfunction was present.

All data were analyzed using SPSS software version 11.5 (SPSS, Inc, Chicago, IL). Fischer's 2-tailed exact test was used to calculate *P* values, except where otherwise noted.

Results

Seventy-seven biopsies were performed in 70 patients over 17 months. Two patients, each with a unilateral biopsy, were lost to follow-up and excluded from the study. The majority of patients were female (n = 46; 67.6%), white (51; 75.0%), and on ≥1 blood thinners (40 [58.8%]; Table 1). The mean age was 72.6 years (range, 51–96).

Complications were seen in 22.6% of biopsies, including extensive ecchymosis, infection, and brow ptosis. Extensive ecchymosis was noted in 4 cases (5.33%), but was not related to postoperative brow ptosis ($P = 0.6278$). Infection was seen in 2 cases (2.67%) and was also not correlated with postoperative brow ptosis ($P = 0.3200$).

Twelve of the 75 biopsies (16.0%) had postoperative frontalis dysfunction at the initial 7- to 10-day follow-up (Fig 2). None of the bilateral TAB cases had frontalis paresis. Of the patients with frontalis dysfunction, complete resolution of brow ptosis (Fig 3) was found in 7 (58.3%) at a mean of 4.43 months (range, 1–6). Frontalis function did not improve in 25%, and 16.7% have shown some improved function over 6 months (Fig 4). Of all patients undergoing TAB, 4% showed frontalis dysfunction with no improvement at ≥6 months. No patients developed orbicularis oculi paresis.

Variables of patient gender, perceived difficulty of surgery, patient use of blood thinners, biopsy result, surgeon, patient race/ethnicity, extensive postoperative ecchymosis, and intraoperative bleeding were analyzed and none were found to be significant in relation to postoperative brow ptosis (Table 2). The length of the incision and the specimen in relation to brow ptosis were calculated using an unpaired *t* test. Both measurements were not significant in relation to brow ptosis ($P = 0.3879$ and 0.6801, respectively).

Greater distances from incision to both the lateral brow and the lateral orbital rim had significantly less brow ptosis (2 tailed *t* test $P = 0.0383$ and 0.0151, respectively). An analysis of distance from the incision to the lateral brow by rolling 1-mm increments showed a statistically significant increased incidence of brow ptosis between 22 and 35 mm from the brow, with 4 of the 20 patients (20.0%) developing brow ptosis ($P = 0.0018–0.0192$; Fig 5). Only 1 patient (1/12; 8.33%) with an incision >35 mm from the brow developed ptosis. The same analysis from the lateral orbital rim was significant between 29 and 34 mm from the rim, with 3 of 6 patients (50.0%) developing brow ptosis ($P = 0.0018–0.0192$; Fig 6). Only 1 patient (1/30; 3.33%) with an incision >34

Table 1. Distribution of Patient Self-reported Race/Ethnicity

Race/Ethnicity	N	%
White	51	75.0
Black	11	16.2
Latino/Hispanic	5	7.3
Asian	1	1.5

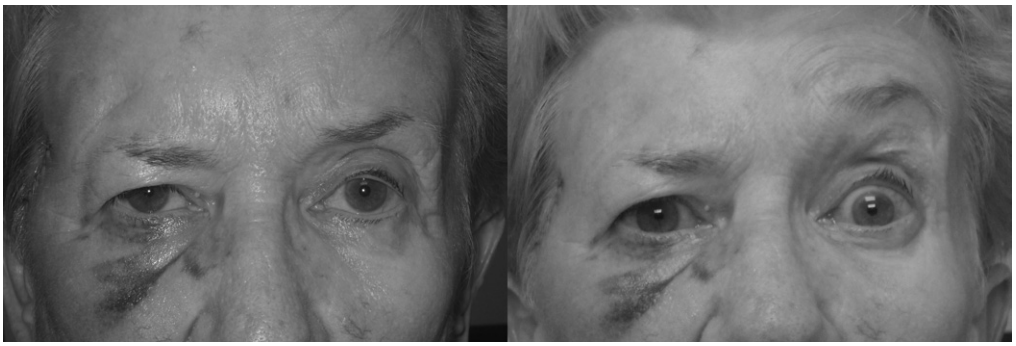

Figure 2. Postoperative photos of patient demonstrating right-sided brow ptosis. Left, at rest, note brow asymmetry. Right, with frontalis activation, note complete lack of right brow elevation.

mm from the lateral orbital rim developed ptosis; this patient's incision was also 32 mm from the brow.

In 10 cases, the location of the incision was above the brow, and no distance measurement could be performed because of lack of anatomic landmarks; none of these cases had postoperative brow ptosis. A comparative analysis of three anatomic zones (incisions above the brow, 0–35 mm from both the orbital rim and lateral brow, and ≥36 mm from both points) was significant ($P<0.0001$), with the 0-to-35-mm category having the greatest risk for postoperative brow ptosis.

The mean distance of the "safety line" to the rim was 38.55 mm (median, 39; range, 22–60). This mean distance was greater in men (41.63 mm) than women (37.35 mm) and was significant ($P = 0.0238$), most likely reflecting the difference in skull size between men and women.

Also recorded at the time of surgery was the surgeon's opinion of whether the biopsy looked positive or negative based on gross appearance of the TA. The surgeon was correct 95.4% of the time and this was highly significant ($P = 0.0001$). The sensitivity was 91.7% (95% confidence interval [CI], 61–99), with a specificity of 96.2% (95% CI, 87−99). The surgeon's ability to predict the histopathologic results had a positive predictive value of 84.6% (95% CI, 54–98) and negative predictive value of 98.1% (95% CI, 89–99).

Discussion

Generally, TAB is considered a procedure with an overall low risk for complications.[11] A small number of cases with postoperative brow ptosis has been reported in the literature, but to date the incidence and risk factors have not been studied.[5−8] The exact incidence of brow ptosis after TAB is confounded by ≥3 factors. (1) The population at risk for GCA is elderly, and also has a high background incidence of involutional brow ptosis; frontal branch injury may not be noticed by either the patient or physician because of preoperative brow ptosis. (2) A wide variety of "safety" and "danger zones" have been described based on anatomic, cadaveric studies, and the incidence of brow ptosis may vary by specific surgical technique. (3) Many patients needing TAB are referred to a specialist and are then told to follow-up with either their neuroophthalmologist or rheumatologist, and are seen by the surgeon only if incision site problems arise or contralateral TAB is needed[11]; this in fact was the standard of the authors before this study. The issue of anticoagulant management in the perioperative period for oculoplastic surgical procedures has also been raised recently (Dutton J. Controversies in Ophthalmic Plastic and Reconstructive Surgery: Anticoagulation. American Academy of Ophthalmology, Subspecialty Day. Chicago, IL, 2010.), but no data are available regarding any increased hemorrhagic risk or its significance with TAB.

The close anatomic proximity of the temporal branch of the facial nerve to the STA is well known. The anatomic courses of the STA and the frontal branches of the facial nerve have been studied extensively,[12−17] resulting in a variety of zones deemed either safe or dangerous.[9,11,18−23] Given the inherent variability of both the facial nerve and

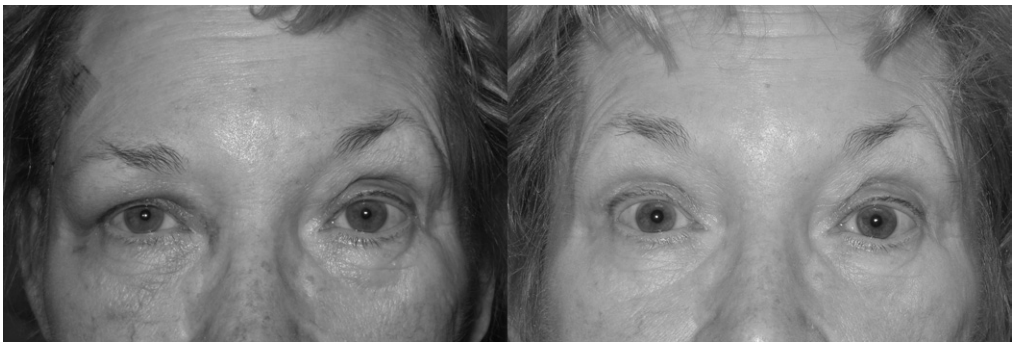

Figure 3. Postoperative clinical photos of patient after temporal artery biopsy on the right. Left, note right brow ptosis with frontalis weakness 1 week after biopsy. Right, 6 months after surgery, frontalis function has fully recovered.

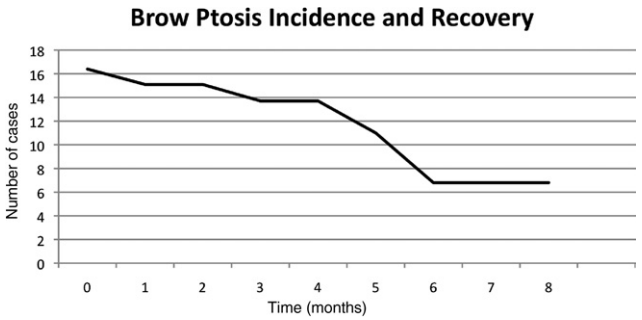

Figure 4. Incidence of brow ptosis after temporal artery biopsy and recovery over time.

the STA, the potential for injury to facial nerve branches during TAB is not surprising. Above the zygomatic arch, the STA travels in a serpiginous and somewhat predictable fashion within the superficial temporal fascia,[11,24] typically bifurcating into an anterior frontal and posterior parietal branch about 3 cm above the zygomatic arch.[23] The peripheral facial nerve has five or more common branching patterns.[15,25,26] The temporal branch, with 2 to 4 terminal twigs, exits the parotid gland and runs deep to the superficial musculoaponeurotic system. Once these fibers cross over the zygomatic arch, the facial nerve branches lie within the anatomic equivalent of the superficial musculoaponeurotic system, traveling just deep to the superficial temporal fascia containing the STA, and course superiorly.[11,18,24,27] The superior path of the nerve may curve posteriorly before coursing anteriorly toward the brow, or follow a more direct path closer to the orbital rim.[28] Of note, the superficial temporal fascia is often thin and ill-defined, and becomes more indistinct with age.[11] At the level of the zygomatic arch, the frontal nerve branches typically congregate in the middle third of a line drawn between the tragus and lateral orbital rim, described by a variety of surface landmarks and ranges as 1.0 to 1.5 cm lateral to the lateral brow, 2 cm lateral to the lower lateral orbital rim, 3.5 cm from the lateral orbital rim at the level of the canthus, 1.0 to 1.5 cm above the superolateral orbital rim, or 0.8 to 3.5 cm anterior to the external auditory canal.[18,24,28,29] About 1 cm above the superior orbital rim, the nerve courses medially, at times as far as the corrugator.[30]

A variety of "safety" and "danger zones" have been described to minimize injury to the temporal branch during facial surgery.[18–24,31,32] Scott et al[20] described a "danger zone" rectangle based at the zygomatic arch and extending from the tragus to the lateral orbital rim, with the superior border at the level of the lateral brow, that contains temporal branches traveling superficially and therefore presumably more susceptible to injury. Liebman et al[23] proposed a smaller, more superior, rectangular, 2-cm-wide "danger zone" for the temporal branch superolateral to the brow. Correia et al[21] reported a triangular "danger zone" using 2 diverging lines starting at the earlobe and extending to the lateral brow and the superior forehead crease. As a variation, "safety lines" have been described in relation to the tragus of the ear and the lateral border of the brow.[9,11,19,24] An incision posterior to these lines theoretically decreases the chance of injury to the temporal branch; incisions anterior to this "safety line" should be avoided. However, as both Dutton et al[33] and Zide[24] have pointed out, there is a great variability in the lateral extent of the brow cilia between individuals, and have suggested either the superior or central aspect of the lateral orbital rim as a more reproducible anatomic landmark. Of note, the description of "safety" and "danger" zones in the literature is based primarily on anatomic, cadaveric studies, and not on intraoperative measurements correlated with postoperative findings.

In addition, TAB technique varies; however, most surgeons make the initial incision directly over the STA to minimize soft tissue dissection, maximize the view of the artery, maximize biopsy length, and minimize injury to frontalis branches located just deep the STA.[11,20] Some authors have also recommended biopsy of the proximal portion of the STA because of its more predictable location and larger caliber,[34] but this may often place the incision within one of the "danger zones" for frontalis branch injury. In our study, the course of the TA was precisely mapped out with Doppler ultrasonography and the incision was made directly over the artery in the area of strongest Doppler signal. Given the variability of "safety" and "danger zones" in the literature, no attempt was made to vary the incision based on the "safety line" chosen in our study. We also measured the distance from the lateral orbital rim to the safety line as part of the data collection.

Based on analysis of our data, several inferences and conclusions can be made. First, a 2-cm distance from the lateral brow was not protective against postoperative brow ptosis. A rolling analysis found that a distance of $\geq$35 mm from the lateral brow was needed to significantly reduce the incidence of this complication. The distance from the orbital rim to the safety line also had a significant variability (range, 22–60 mm), likely reflecting variability in individual physiognomy, gender differences ($P = 0.0238$), and a highly variable position of the lateral brow cilia. Incisions made above the brow had a protective effect compared to incisions closer ($\leq$35 mm) to both the orbital rim and brow. This finding is not surprising based on anatomic studies by Zide,[24] who found that, above the brow, the STA invariably traveled superior to the distal twigs of the frontal branch, and predictably a TAB in this area had a 0% incidence of brow ptosis in our study. Interestingly, the length of incision and specimen did not correlate with the incidence of brow ptosis; in other words, shorter incisions

Table 2. Fischer Exact Test Results by Variable

Variable	*P* Value
Gender (male/female)	0.0531
Patient use of blood thinners (yes/no)	0.0749
Surgeon performing biopsy	0.7617
Postoperative ecchymosis	0.6278
Surgical difficulty (difficult/easy)	0.2982
Biopsy result (positive/negative)	1.2921
Race/ethnicity	0.2828
Intraoperative bleeding	0.2962

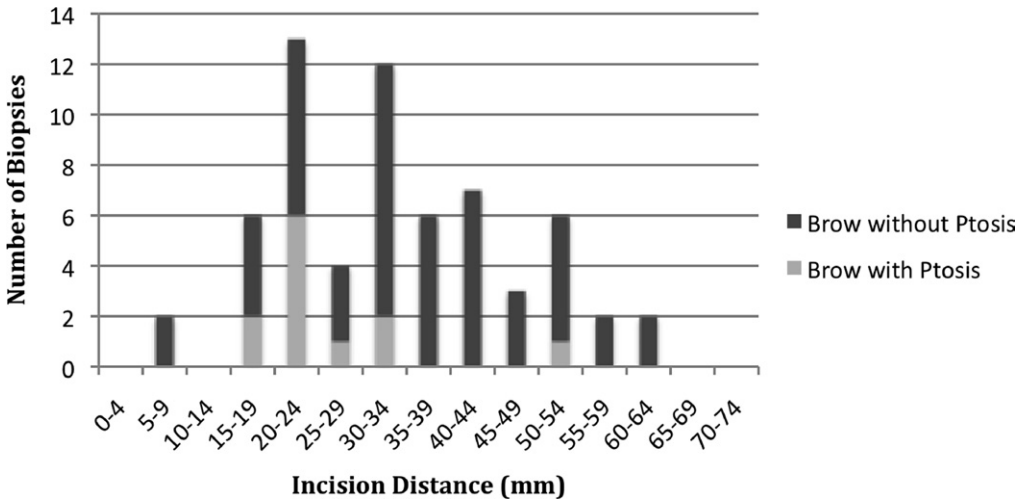

Figure 5. Number of cases with and without brow ptosis by incision distance from lateral brow.

and specimens did not decrease the chance of postoperative brow ptosis. Likewise, the difficulty of the dissection, the perioperative use of blood thinners, biopsy results, or significant postoperative ecchymosis all showed no correlation with brow ptosis; that said, the incidence of brow ptosis with the use of blood thinners did approach significance ($P = 0.0749$). Another finding noted in this study is the positive and negative predictive value of TAB result made by the surgeon based on intraoperative STA appearance, which is consistent with the findings of Cetinkaya et al.[35]

Overall, the incidence of postoperative brow ptosis after TAB was 16.0%, but decreased markedly to 0% both for incisions above the brow and for incisions ≥35 mm from both the lateral brow and the lateral orbital rim. In those patients with postoperative brow ptosis, frontalis function recovered fully in 58.3%, with an additional 16.7% improving over 6 months. Of all patients undergoing TAB ≤4% may have frontalis dysfunction that does not improve.

In conclusion, the incidence of postoperative brow ptosis after TAB is not rare. Patients should be warned of this risk during preoperative counseling, including the potential for no recovery of function. An incision ≥35 mm posterior to both the lateral brow and lateral orbital rim is highly protective against this complication, as are incisions above the brow. The length of the incision and biopsy showed no correlation to the incidence of brow ptosis. Therefore, a shorter incision and biopsy are not justified: Adequate tissue (≥20 mm postfixation) should be obtained in all cases. There was also no increased incidence of brow ptosis or significant ecchymosis in patients using perioperative blood thinners in this cohort, although the strength of this finding is limited because of the overall low incidence of hemorrhagic risk in outpatient oculoplastic procedures. However, based on our patient cohort, there is no evidence to recommend a change in utilization of blood thinners prior to patients undergoing TAB.

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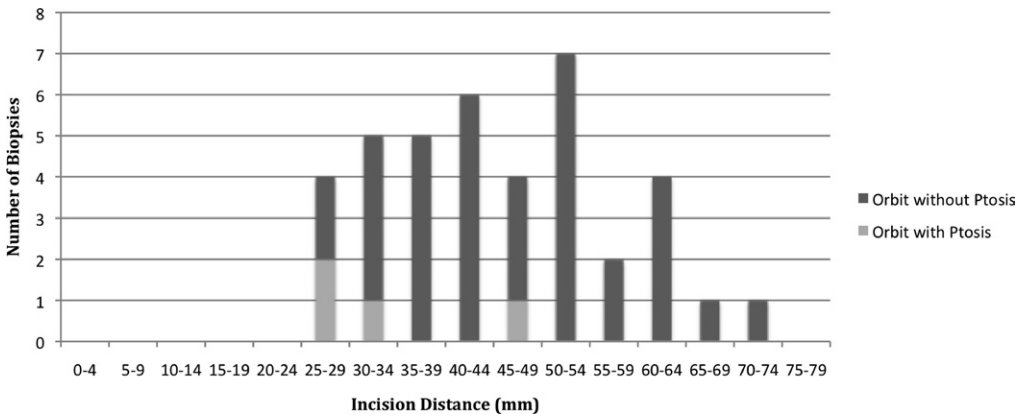

Figure 6. Number of cases with and without brow ptosis by incision distance from orbital rim.

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