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Reconstructive

Impact of Immediate Surgical Reconstruction Following Wide Local Excision of Malignant Head and Neck Melanoma

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Background: The role of surgical reconstruction following melanoma extirpation is well recognized. Although technical considerations depend on patient anatomy and surgeon preference, the optimal timing of reconstruction remains unclear. This study aims to evaluate clinical and oncologic outcomes in melanoma extirpation followed by immediate reconstruction.

Methods: We retrospectively identified patients who underwent immediate reconstruction following head and neck melanoma excision at our institution between January 2013 and December 2016. Demographic and clinical characteristics, operative variables, and outcome data were extracted.

Results: Overall, 197 patients (male 70.6%) underwent excision followed by immediate reconstruction. Of the 70 patients with a history of cutaneous malignancy, 46 (65.7%) had a prior melanoma and 26 (37.1%) had 2 or more types of skin cancers. Of the 202 lesions resected, 138 (68.3%) were invasive, whereas 64 (31.7%) were in situ. The most frequent anatomic location involved was the cheek (34.2%), followed by scalp (31.2%). Reconstruction technique varied, with 116 (57.4%) lesions repaired by adjacent tissue transfer, 24 (11.9%) by full-thickness skin graft, 23 (11.4%) by complex primary closure, 17 (8.4%) by split-thickness skin graft, and 22 (10.9%) by more than 1 technique. On postoperative pathologic assessment, 2 patients had positive margins and 5 experienced local recurrence (mean follow-up: 2.3 years). In an unadjusted bivariate analysis, history of melanoma ($P = 0.015$) was significantly associated with local recurrence.

Conclusions: Reconstruction at time of excision is an oncologically safe approach for the management of patients with malignant melanoma. A prior history of melanoma may be associated with local recurrence. *(Plast Reconstr Surg Glob Open 2020;8:e2661; doi: 10.1097/GOX.0000000000002661; Published online 24 February 2020.)*

INTRODUCTION

Head and neck skin cancers typically refer to squamous cell carcinomas (SCCs), basal cell carcinomas (BCCs), and melanoma. Although BCC is the most frequent form of cutaneous neoplasm, melanoma is associated with the worst clinical outcomes.[1] Cutaneous melanoma is the sixth most common cancer in the United States, with a population incidence that has steadily risen over the past 4 decades.[2] Although it constitutes only 3%–5% of new skin cancer diagnoses each year, melanoma is by far the most lethal form of cutaneous malignancy, responsible for approximately 65% of all skin cancer-related mortalities.[2,3] Risk factors for malignant melanoma include family history, ultraviolet-b (UV-B) radiation exposure, age, and presence of dysplastic nevi.[4,5] Given the widespread prevalence of these risk factors, as well as the locational variation of different melanoma subtypes on the body surface, an accurate calculation of melanoma frequency in the population remains unclear.

Although recent advancements in immunotherapies have improved the care of patients with metastatic disease,

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surgery remains the gold standard in the management of early malignant melanoma. The goal of surgery is to excise the primary tumor along with adjacent normal tissue to prevent disease progression.[3] Adequate surgical margins are essential for a successful surgical outcome and are based on the depth of primary tumor invasion. Mohs micrographic surgery has been extremely successful with nonmelanoma skin cancer; however, wide surgical excision still remains the standard of care for melanoma.[6] In cases requiring wide excision margins, subsequent surgical reconstruction may be necessary for adequate closure. The approaches to surgical reconstruction include healing by secondary intention, primary closure, split- and full-thickness skin grafting, local tissue rearrangement, axial pattern flaps, or free flaps and depend on anatomic involvement, patient aesthetic considerations, and surgeon preference.[7]

In addition to adequate surgical margins for successful operative results, sentinel lymph node biopsy has been shown to be a valuable staging procedure and can help guide therapy. According to the American Society of Clinical Oncology and Society of Surgical Oncology guidelines established in 2012, sentinel lymph node biopsy was recommended for patients with intermediate-thickness melanomas (Breslow thickness, 1–4 mm) of any anatomic site and considered for patients with American Joint Committee on Cancer T4 melanomas (>4 mm) for staging purposes and to facilitate regional disease control.[8] Updated guidelines from 2017 continued the same recommendation but also advise sentinel lymph node biopsies in T1b melanomas (0.8–1 mm or <0.8 mm with ulceration).[9]

Despite performing a wide surgical excision, local recurrence or positive final margins of melanoma are not rare and are associated with increased morbidity and mortality.[10] Currently, it is unknown whether surgical reconstruction modality has any influence on disease recurrence and the optimal timing of surgical reconstruction remains unclear. Therefore, the goal of this retrospective chart study is to evaluate clinical and oncologic outcomes in patients undergoing malignant melanoma extirpation followed by immediate surgical reconstruction.

PATIENTS AND METHODS

After review and approval by the University of California, Irvine Institutional Review Board (HS#2017-3522), all patients who underwent immediate surgical reconstruction following wide local excision (WLE) of biopsy-proven malignant melanoma of the head and neck between January 2013 and December 2016 were identified. This resulted in a total of 241 patients. Patients were excluded if medical records were incomplete, final pathology demonstrated nonmelanoma histology, or if multidisciplinary evaluation by both surgical oncology and plastic surgery was not performed. Demographic data included diagnosis, average age at time of operation, sex, past skin cancer history, as well as mean and median follow-up time. Clinical characteristics such as melanoma type (eg, in situ, superficial spreading melanoma, lentigo maligna melanoma, nodular melanoma, desmoplastic melanoma, not specified), tumor location, and tumor stage (ie, Breslow thickness, mitotic rate, satellitosis, and ulceration) were included. Operative variables include operative time, margin, defect size, and reconstruction type (eg, primary closure, adjacent tissue transfer, split- or full-thickness skin graft). Oncologic outcomes such as sentinel lymph node status following WLE, final margin pathology, and cancer recurrence were obtained.

Margins and Cancer Staging

Surgical margins were based on Breslow thickness from initial biopsy. At the time of melanoma resection, specimens were sent for permanent pathologic evaluation instead of frozen sections, and therefore, results were not available at time of immediate reconstruction. To stage the cancer, sentinel lymph node biopsy was performed in patients with melanoma ≥1 mm or <1 mm but with high-risk features such as mitoses or other medical comorbidities. The seventh edition of the American Joint Committee on Cancer was utilized as this study analyzed patient data from January 2013 to December 2016, before the new 2017 guidelines.

Operative Technique

Patients included in this study were evaluated by both surgical oncology or rarely dermatologic surgery and plastic surgery. All tumor extirpations were performed by 3 surgical oncologists and 1 dermatologic surgeon. Selection for reconstructive modality was multifactorial, depending on anatomic location, defect size, patient aesthetic consideration, and surgeon preference. Figures 1–5 illustrates a detailed case example.

Statistical Analysis

Descriptive statistics were summarized, and chi-square tests were used for bivariate analysis in SPSS 17 (SPSS, Inc., Chicago, Ill.) All calculated P values were 2-tailed. Values of $P<0.05$ were considered statistically significant.

RESULTS

Patient Demographics

After applying exclusion criteria, 197 patients (139 males, 70.6%) who underwent WLE of malignant

Fig. 1. Melanoma lesion in the left upper cheek.

Fig. 2. Defect after 1 cm margin WLE.

Fig. 3. Reconstruction with a rhomboid flap.

Fig. 4. Closed defect.

Fig. 5. Patient shown 3 months after excision with negative margins.

melanoma followed by immediate surgical reconstruction in the head and neck region were included for analysis. Table 1 summarizes the demographic and clinical characteristics of these patients. The mean age of patients at time of surgery was 67.3 years (range, 16–95 years). Of the 70 patients with a history of cutaneous malignancy, 44 (62.9%) had 1 type of skin cancer, 21 (30.0%) had 2 types of skin cancers, and 5 (7.1%) had all 3 types of skin cancers, including melanoma and nonmelanoma histology. Of the patients with only one previous type of cutaneous cancer, 31 (70.5%) patients had a history of only melanoma, 8 (18.2%) patients of BCC, and 4 (9.1%) patients of SCC. Of those with a history of 2 types of skin cancers, 11 (52.4%) had SCC and BCC, 7 (33.3%) had melanoma and SCC, and 3 (14.3%) had melanoma and BCC. Overall, 46 (23.4%) of all patients included in this study had a prior melanoma. The mean follow-up time following surgical reconstruction was 2.3 years (SD, 1.4 years).

Tumor Characteristics

In total, 202 lesions from 197 patients were resected. Of these, 138 (68.3%) were invasive (T1–4) and 64 (31.7%) were classified as melanoma tumor in situ (Tis) following initial biopsy. In the invasive melanoma cohort, mean tumor thickness was 1.5 mm (SD, 2.2 mm) resulting in an average maximum defect length of 4.5 cm (SD, 2.1 cm) after tumor resection. Sentinel lymph node biopsy was performed for 49 patients with melanoma of Breslow thickness ≥1 mm and 20 patients with melanomas <1 mm but with high-risk features. Of the total 69 patients (35.0%) who underwent sentinel lymph node biopsies, 6 patients (8.7%) had lymph nodes that were positive for metastatic melanoma. The most frequent anatomic location involved was the cheek (69, 34.2%), followed by the scalp (63, 31.2%), ear (19, 9.4%), nose (16, 7.9%), temple (16, 7.9%), forehead (14, 6.9%), neck (2, 1.0%), lip (2, 1.0%), and chin (1, 0.5%). More tumors were found

Table 1. Patient Demographics

Characteristic	Value (%), n = 197
Mean age, y (range)	67.3 (16–95)
Sex	
Female	58 (29.4%)
Male	139 (70.6%)
Skin cancer history	
None	127 (64.5%)
One type	44 (22.3%)
Two types	21 (10.7%)
Three types	5 (2.5%)
Medical history	
Melanoma	46 (65.7%)
Squamous cell carcinoma	27 (38.6%)
Basal cell carcinoma	27 (38.6%)
Not otherwise specified	1 (1.4%)
Skin cancer history	
Melanoma	31 (44.3%)
Melanoma + SCC	7 (10.0%)
Melanoma + BCC	3 (4.3%)
Melanoma + SCC + BCC	5 (7.1%)
SCC	4 (5.7%)
SCC + BCC	11 (15.7%)
BCC	8 (11.4%)
Not otherwise specified	1 (1.4%)
Mean length of follow-up, y (range)	2.3 (0–5.9)

Table 2. Tumor Characteristics

Characteristic	Value (%), n = 202
Melanoma type	
In situ	64 (31.7)
Invasive	138 (68.3)
Mean Breslow thickness, mm (SD)	1.5 (2.2)
AJCC tumor classification	
Tis	64 (31.7)
T1a	58 (28.7)
T1b	20 (9.9)
T2a	24 (11.9)
T2b	7 (3.5)
T3a	10 (5.0)
T3b	3 (1.5)
T4a	9 (4.5)
T4b	3 (1.5)
N/A	4 (2.0)
Anatomic location	
Cheek	69 (34.2)
Scalp	63 (31.2)
Ear	19 (9.4)
Nose	16 (7.9)
Temple	16 (7.9)
Forehead	14 (6.9)
Neck	2 (1.0)
Lip	2 (1.0)
Chin	1 (0.5)
Laterality	
Right	74 (36.6)
Left	85 (42.1)
N/A	43 (21.3)
Number upstaged	21 (10.7)
Number positive margins	2 (0.9)
Number recurrence	5 (2.5)
Mean time to recurrence, m (SD)	12.4 (6.2)

AJCC, American Joint Committee on Cancer; N/A, not available; Tis, tumor in situ.

Table 3. Operative Variables

Characteristic	Value (%)
Mean time in operating room, min (range)	
Total OR time	130.7 (46–320)
Surgery time	81.9 (21–233)
Mean excision margins, cm	
Tis	0.8
T1	1.1
T2	1.4
T3	1.9
T4	1.9
Sentinel lymph node biopsy	
Yes	69 (34.1%)
No	133 (65.8%)
Sentinel lymph node biopsy for each AJCC T category	
Tis	0 (0%)
T1a	8 (13.8%)
T1b	14 (70.0%)
T2a	18 (75.0%)
T2b	4 (57.1%)
T3a	8 (80.0%)
T3b	3 (100%)
T4a	7 (77.8%)
T4b	3 (100.0%)
N/A	4 (100%)
Mean defect length, cm (range)	
Minimum length	3.6 (1–11)
Maximum length	4.5 (1–15)
Reconstruction modality	
Primary closure	23 (11.4%)
Adjacent tissue transfer	116 (57.4%)
FTSG	24 (11.9%)
STSG	17 (8.4%)
More than 1 technique	22 (10.9%)
Types of adjacent tissue transfer	
Advancement flap	57 (45.2%)
Transposition flap	33 (26.2%)
Rotational flap	30 (23.8%)
Local flap	3 (2.4%)
Face-lift flap	3 (2.4%)

AJCC, American Joint Committee on Cancer; FTSG, full-thickness skin graft; N/A, not available; OR, operating room; STSG, split-thickness skin graft; Tis, tumor in situ.

on the left (85, 42.1%) side than the right (74, 36.6%) (Table 2).

Operative Variables

The mean time for surgical WLE and reconstruction was 81.9 minutes (range, 21–233 minutes). Surgical margins were determined by the National Comprehensive Cancer Network guideline based on Breslow depth. Average defect size was 3.6 × 4.5 cm. Surgical reconstruction technique varied considerably in this cohort, with 116 (57.4%) lesions repaired by adjacent tissue transfer, 24 (11.9%) by full-thickness skin graft, 23 (11.4%) by complex primary closure, 17 (8.4%) by split-thickness skin graft, and 22 (10.9%) by more than 1 reconstructive technique. Of the patients who received only adjacent tissue transfer reconstruction or in combination with another reconstructive technique, 57 (45.2%) were advancement flaps (eg, Antia Buch helical, V-Y, etc.), 33 (26.2%) were transposition flaps (eg, rhomboid, bilobed, nasolabial, etc.), 30 (23.8%) were rotational flaps, 3 (2.4%) were local flaps (eg paramedian flap), and 3 (2.4%) were face-lift flaps. Other operative variables are contained in Table 3.

Recurrence

Overall, 5 patients experienced local recurrence during the follow-up period. The mean time to recurrence was 12.8 months (range, 6.6–22.5 months) (Table 2). All 5 recurrences occurred in men and were diagnosed as invasive melanoma. Most recurrent lesions were found on the scalp or cheek. Of the patients with recurrence, 3 had sentinel lymph node biopsy during initial surgery, all of which were negative for metastatic melanoma. History of melanoma was found to be significantly associated with local recurrence following resection (60.0% versus 22.4%, $P = 0.015$). Table 4 highlights the characteristics of patients with recurrence.

Positive Margins

On pathologic assessment, 21 (10.4%) lesions were upstaged and 2 (0.99%) were found to have positive margins (Table 2). Of the 2 patients with positive margins, 1 received sentinel lymph node biopsy during initial surgery with negative findings. Both patients with positive margins were women and underwent reexcision, with subsequent negative margins obtained for one patient. The other patient required a second reexcision before negative margins were obtained. The patient with persistent positive margins was initially reconstructed with local flap rearrangement but underwent primary closure of a small linear defect at reoperation. Two of the patients with recurrence had positive margins from the excised recurrent lesions, but both had successful reexcisions resulting in negative margins. Table 5 highlights the variables of patients with positive margins.

Table 4. Recurrence Cohort

Age	Sex	Skin Cancer History	Melanoma Type	Location	Tumor Thickness (mm)	AJCC Tumor Classification	Margins (cm)	Defect Size (cm)	SLNB	Initial Reconstruction	Time to Recurrence (m)	Margins at Reoperation (cm)	Reconstruction at Reoperation
77	M	Melanoma, SCC	NOS	Scalp	1.5	T2a	2	6 × 6	Yes; negative	FTSG	22.5	1.5	FTSG
86	M	None	Nodular	Nose	1.3	T2a	1.5	2.5 × 4	No	Advancement flap, FTSG	8.5	N/A	Advancement flap
66	M	Melanoma, SCC, BCC	NOS	Cheek	0.3	T1a	1	3.5 × 3.5	No	Advancement flap	6.6	0.8	Z-plasty
87	M	Melanoma	NOS	Cheek	0.9	T1b	1	4 × 4	Yes; negative	Advancement flap	10.8	1	Advancement flap
58	M	None	NOS	Scalp	3.8	T3a	2	8.5 × 9	Yes; negative	STSG	13.6	N/A	FTSG

AJCC, American Joint Committee on Cancer; FTSG, full-thickness skin graft; M, male; N/A, not available; NOS, not otherwise specified; SLNB, sentinel lymph node biopsy; STSG, split-thickness skin graft.

Table 5. Positive Margins Cohort

Age	Sex	Skin Cancer History	Melanoma Type	Location	Tumor Thickness (mm)	AJCC Tumor Classification	Margins (cm)	Defect Size (cm)	SLNB	Initial Reconstruction	Margins at Reoperation (cm)	Reconstruction at Reoperation
61	F	Melanoma	Nodular	Nose	FNA	FNA	1	3.5 × 3.5	Yes; negative	Cheek rotational flap, nasalis muscle flap, intraoral advancement flap, Integra	N/A	Cheek rotational flap, RFFF, FTSG, STSG
68	F	SCC and BCC	NOS	Scalp	0.5	T1a	1	1.8 × 3	No	Local tissue rearrangement	0.5	Primary closure

AJCC, American Joint Committee on Cancer; F, female; FNA, fine-needle aspiration; FTSG, full-thickness skin graft; N/A, not available; NOS, not otherwise specified; RFFF, radial free forearm flap; SLNB, sentinel lymph node biopsy; STSG, split-thickness skin graft.

DISCUSSION

Cutaneous melanoma is the sixth most common cancer in the United States and is responsible for 65% of all skin cancer-related mortalities.[2,3] Internationally, the annual total of deaths associated with melanoma is approximately 50,000.[11] Because melanoma recurrence portends a poor prognosis, the current standard of care is aggressive WLE surgery, which can be curative for many patients.[3] Margins are determined by tumor thickness and can often result in large defects requiring advance surgical reconstructive methods. In this study, we evaluated the clinical and oncologic outcomes of patients undergoing malignant melanoma extirpation followed by immediate surgical reconstruction.

In addition to describing our experience, we sought to determine if any patient, clinical, or surgical characteristics were associated with incidence, recurrence, and positive margins. The higher prevalence of left-sided melanoma observed in this study is in accordance with other recent studies and could be associated with increased UV light exposure on the left side of the body while driving or riding in an automobile.[12,13] Thus, it may be prudent to advise patients who spend a significant amount of time driving to use UV defensive measures such as sunscreen and protective garments. Overall, we found that there was a low rate of recurrence (2.5%) and positive margins (0.9%) after immediate reconstruction. These findings suggest that immediate reconstruction is an acceptable approach to the surgical management of malignant melanoma. In an analysis of the factors associated with recurrence, we observed an increased incidence of male sex, older age, and advanced clinical stage. However, given the small number of patients experiencing a local recurrence in this series, the only variable associated with

Table 6. Published Rates of Positive Margins after WLE of Head and Neck Malignant Melanoma

Study	Rate of Positive Margins (Number/Total)	Location	Reconstruction Modality	Average Follow-Up Time (mo)
Demer et al[14] (2019)	6.2% (6/97)	Head and neck, NOS	N/A	20
Koolen et al[15] (2017)	18.8% (39/207)	Head and neck, NOS	N/A	48.2
Miller et al[16] (2017)	12.1% (25/207)	Head and neck, NOS	N/A	N/A
Karanetz et al[7] (2016)	1.7% (9/534)	Cheek (6) Scalp (1) Ear (1) Back (1)	N/A	14.4
Mangold et al[17] (2016)	14.1% (19/135)	Head and neck, NOS	N/A	56.4*
Parrett et al[18] (2014)	5.3% (4/76)	Cheek (2) Temple (1) Submandible (1)	Rhomboid flap (2) Free thigh flap (1) Cheek rotational flap (1)	24*
Christophel et al[19] (2013)	11.7% (48/412)	Cheek (15) Scalp (7) Nose (6) Forehead (5) Neck (5) Ear (5) Temple (3) Eyelid (2)	N/A	N/A
Sullivan et al[20] (2012)	1.4% (1/72)	Scalp	Adjacent tissue transfer	62.4
Sullivan et al[21] (2009)	6.0% (7/117)	Cheek (5) Forehead (1) Neck (1)	Adjacent tissue transfer (4) Skin graft (3)	N/A
Berdahl et al[22] (2006)	5.0% (2/40)	Upper face, NOS	N/A	37.6
Glat et al[23] (1997)	2.5% (1/40)	Periorbital	Full-thickness skin graft	68.4

*Median reported.
N/A, not available; NOS, not otherwise specified.

Table 7. Published Rates of Recurrence after Obtaining Negative Margins following WLE of Head and Neck Malignant Melanoma and Immediate Reconstruction

Study	Rate of Recurrence (Number/Total)	Reconstruction Modality	Average Follow-Up Time (mo)
Koolen et al[15] (2017)	49.0% (70/143)	Skin graft (35) Skin flap (24) Primary closure (6) Combination (5)	47.8
Parrett et al[18] (2014)	2.6% (2/76)	N/A	24*
Sullivan et al[20] (2012)	1.4% (1/72)	Full-thickness skin graft (1)	62.4
Buck et al[24] (2012)	5.9% (3/51)	N/A	26.9
Sekido et al[25] (2005)	0% (0/34)	0	36
Glat et al[23] (1997)	0% (0/40)	0	68.4
Lent et al[26] (1994)	0% (0/36)	0	37.5

*Median reported.
N/A, not available.

recurrence on statistical analyses was a prior history of melanoma ($P = 0.015$).

Our findings are consistent with prior studies, which have described similar rates of positive margins for WLE of melanoma in the head and neck region (ranging from 1.7% to 18.8%) (Table 6).[7,14–23] However, recurrence rates following immediate surgical reconstruction in the literature have been more variable (ranging from 0% to 49.0%) (Table 7).[15,18,20,23–26] This variability may be due to differences in follow-up time (ranging from mean 26.9 to 68.4 months) and lesion location across published studies. Additionally, some institutional studies have been limited by significant loss to follow-up, whereas others have deliberately excluded patients with inadequate follow-up information. Although this methodology may be required for the appropriate analysis of a given study, together these limitations certainly restrict the ability to capture an accurate rate of recurrence in this population. However, despite the variability in institutional reports, similar trends have been described in a recent systematic review by Quimby et al.[27] After analyzing the incidence of positive margins and local recurrence across 9 studies, these authors conclude that immediate reconstruction is an oncologically sound alternative to delayed reconstruction following melanoma excision.[27]

During analysis of demographic factors predictive of recurrence in this series, we found that patients who experienced a local recurrence were more likely to be male (100% in our recurrence cohort versus 69.8% in nonrecurrence cohort) and of older age (mean age of 74.8 in recurrence cohort versus 67.3 in nonrecurrence cohort). However, these absolute differences were not statistically significant due to the small study sample size. Although there are no previous studies to our knowledge that analyze gender and melanoma recurrence, similar observations of higher recurrence rates in men were made by Berdahl et al.[22] This may be due to the slower adoption of skin protective behavior among men compared with women who are better versed in using sun protection and limiting outdoor activities.[28] Furthermore, other studies have demonstrated an association between increasing age and positive margins at time of extirpation,[16,21] but no studies have examined associations between age and recurrence. Future studies using larger patient populations are necessary to validate these demographic trends.

In addition to predictors of recurrence, we also noticed that patients with local recurrence and positive margins had invasive melanoma (3 with T1, 2 with T2, and 1 with T3). Although this is rather expected given the more aggressive nature of invasive melanoma, the current literature is sparse and inconsistent with regards to recurrence and Breslow thickness.[15,18] The increased incidence of recurrence and positive margins among patients with invasive disease in our study suggests that such patients should be monitored more closely after excision and reconstruction.

This study has several limitations. We did not have any delayed reconstruction patients at our institution for comparison. Also, as previously stated, the low number of patients with melanoma recurrence and positive margins could potentially result in missed patient and tumor characteristics that may be associated with positive margins and/or recurrence. The small sample size also precluded our ability to apply advanced statistical tests, and all statistical associations reported here were ascertained through bivariate methods. Lastly, despite a follow-up time that is comparable to previously published studies on this topic, a longer follow-up time is certainly preferable to fully capture the recurrence rate in this population over time.

CONCLUSION

Reconstruction at time of WLE is an oncologically sound alternative to delayed reconstruction in patients with malignant melanoma of the head and neck. A prior history of melanoma may be associated with local recurrence.

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