

A Classification System and Surgical Algorithm for Pediatric Postburn Ear Deformities

Martin R. Buta, MD, MBA¹⁻³, Matthew A. DePamphilis, BS^{1,4},
Branko Bojovic, MD¹⁻³, Richard Ehrlichman, MD¹⁻³, Daniel N. Driscoll, MD¹⁻³

¹Shriners Hospitals for Children, Boston, MA; ²Division of Plastic and Reconstructive Surgery, Massachusetts General Hospital, Boston, MA; ³Harvard Medical School, Boston, MA; ⁴Boston University School of Medicine, Boston, MA

INTRODUCTION

The outward projection of the external ear makes this anatomically complex appendage susceptible to trauma. Notably, up to 25% of facial burns involve the ear, frequently impacting function, aesthetics, and quality of life. Scar tissue and contracture, traumatized cartilage, and compromised blood supply and surrounding soft tissues all influence the reconstructive plan. The authors describe a new classification system and surgical algorithm for pediatric postburn ear deformities informed by both their extensive operative experience on the traumatized ear and a retrospective study of different reconstructive techniques for more severe burn injuries to the pediatric ear.

METHODS

To develop the classification system and surgical algorithm, three senior surgeons with over 85 years of combined experience reconstructing ears carried out an iterative joint review of their relevant clinical cases and insights, including their personal approach to assessing postburn ear trauma and developing an operative plan. Particular attention was focused on how the type and extent of soft tissue injury affects available reconstructive options.

To inform classification of the most complex ear burn cases, a retrospective review was conducted on patients aged 0 to 21 years who underwent cartilage framework reconstruction between January 2004 to January 2021 at a specialized pediatric burn center. Medical records were screened and 54 patients (61 ears) who met study criteria were identified and patient demographics, procedural characteristics, and outcomes were analyzed.

RESULTS

Variable	Porous Polyethylene Implant	Costal Cartilage Graft	Composite Graft	Conchal Transposition Flap
Total patients, N	20	4	9	21
Age at injury (years), Mean (SD*)	5.1 (5.6)	3.8 (3.6)	5.0 (4.8)	8.2 (5.4)
Male birth sex, % (N)	60 (12)	50 (2)	56 (5)	62 (13)
US residence, % (N)	45 (9)	50 (2)	11 (1)	19 (4)
Race, % (N)				
Caucasian	30 (6)	75 (3)	56 (5)	29 (6)
African American	35 (7)	0 (0)	11 (1)	19 (4)
Asian	10 (2)	0 (0)	0 (0)	0 (0)
Other	25 (5)	25 (1)	33 (3)	52 (11)
Hispanic or Latinx ethnicity, % (N)	40 (8)	75 (3)	67 (6)	81 (17)

*SD = standard deviation

Variable	Porous Polyethylene Implant	Costal Cartilage Graft	Composite Graft	Conchal Transposition Flap
Burn size (% TBSA*), Mean (SD)	36.7 (22.7)	29.3 (26.0)	32.8 (20.7)	31.8 (17.8)
Burn mechanism, % (N)				
Flame	65 (13)	75 (3)	67 (6)	76 (16)
Scald	5 (1)	25 (1)	11 (1)	0 (0)
Electrical	15 (3)	0 (0)	22 (2)	14 (3)
Chemical	15 (3)	0 (0)	0 (0)	10 (2)

*TBSA = total body surface area

Variable	Porous Polyethylene Implant	Costal Cartilage Graft	Composite Graft	Conchal Transposition Flap
Total ears, N	23	5	9	24
Age at reconstruction start (years), Mean (SD)	12.0 (5.3)	13.2 (5.3)	14.0 (5.1)	15.1 (4.5)
Time since burn injury (years), Mean (SD)	5.8 (4.1)	8.4 (6.4)	9.5 (5.2)	7.3 (3.4)
Laterality % R ear, % (N)	52 (12)	60 (3)	56 (5)	58 (14)
Helical rim repair, % (N)	87 (20)	40 (2)	100 (9)	100 (9)

Variable	Porous Polyethylene Implant	Costal Cartilage Graft	Composite Graft	Conchal Transposition Flap
Complications, % (N)	13 (3)	20 (1)	11 (1)	(0)
Infection, % (N)	4.3 (1)	20 (1)	11 (1)	(0)
Extrusion, % (N)	8.7 (2)	(0)	(0)	(0)
Total off operations, Mean (SD)	3.5 (1.5)	3.2 (2.2)	2.0 (1.0)	1.8 (0.4)
Length of follow up (years), Mean (SD)	6.1 (4.0)	3.2 (5.1)	3.1 (3.0)	2.8 (3.2)

RESULTS

For postburn ear deformities (Table 1) involving total or near-total preservation of the ear's anatomical structural elements (Type I and Type II deformities, respectively), scar release, local tissue rearrangement, and/or skin grafting are typically sufficient for optimal reconstruction.

For cartilage defects involving less than or more than two-thirds of the helix (Type III and Type IV deformities, respectively), a partial to complete ear scaffold can be successfully reconstructed using a composite graft, conchal transposition flap, costal cartilage graft, or porous polyethylene implant.

CONCLUSION

The proposed classification system and surgical algorithm for postburn ear deformities facilitate a tailored approach that addresses reconstructive course duration, anticipated aesthetic results, complication potential, and patient goals and expectations.

DISCLOSURES

The authors have no financial conflicts of interest to disclose.

FUNDING AND SUPPORT

No funding was provided in support of this study.

TABLE 1: CLASSIFICATION OF PEDIATRIC POSTBURN EAR DEFORMITIES

Type	Description	Surgical Options
I	<ul style="list-style-type: none"> Deformity due to scar and/or keloid only without contracture Adequate preservation of cartilage and soft tissue Preservation of anatomical structural elements 	<ul style="list-style-type: none"> Local tissue rearrangement (e.g. Z-plasty, V-Y plasty, etc.) Keloid – excision with local tissue rearrangement (e.g. Z-plasty, V-Y plasty, etc.) or skin grafting, if needed
II	<ul style="list-style-type: none"> Deformity due to scar contracture and minimal soft tissue loss Adequate preservation of cartilage and anatomical structural elements Intrinsic and/or extrinsic contracture(s) may be present 	
IIA	Intrinsic contracture (contracture involves only ear structures)	<ul style="list-style-type: none"> Contracture release with or without skin grafting Local tissue rearrangement (e.g. Z-plasty, V-Y plasty, etc.) Otoplasty
IIB	Extrinsic contracture (contracture involves only preauricular, retroauricular, and/or temporoparietal tissues)	
IIC	Intrinsic and extrinsic contractures	
III	Subtotal cartilage and/or other soft tissue loss	
IIIA	Cartilage defect and/or other soft tissue loss involving <1/3 of helix	<ul style="list-style-type: none"> Partial scaffold placement, e.g. ipsilateral or contralateral composite graft, conchal transposition flap, costochondral cartilage graft, posterior ear cartilage graft, nasal septal cartilage graft
IIIB	Cartilage defect and/or other soft tissue loss involving 1/3 to 2/3 of helix	<ul style="list-style-type: none"> Skin and/or fascia flap e.g. retroauricular skin flap, retroauricular fascial flap, temporoparietal fascia flap, preauricular skin flap
IV	Major cartilage and soft tissue loss, with cartilage defect involving >2/3 of helix, requiring total or near-total ear reconstruction	<ul style="list-style-type: none"> Major scaffold placement e.g. costochondral cartilage graft, microporous polyethylene implant Skin and/or fascia flap e.g. retroauricular skin flap, retroauricular fascial flap, temporoparietal fascia flap, preauricular skin flap

SURGICAL ALGORITHM FOR PEDIATRIC POSTBURN EAR CARTILAGE DEFORMITIES

