Pediatric Patients with Post-Burn Amputations Report Worse Long-Term Physical Function but Not Self Appearance

Deborah Choe, BA[1], Andrew Humbert, PhD[2], Erin Wolfe, MD[3], Sarah A. Stoycos, PhD[4], Samuel Mandell, MD, MPH[5], Barclay T. Stewart, MD, PhD, MPH[6], Gretchen J. Carrougher, MN, RN, CBRN[6], Karen Kowalske, MD[5], Jeffrey C. Schneider, MD[7], David M. Crandell, MD[7], Haig A. Yenikomshian, MD[3]

[1]Keck School of Medicine of University of Southern California, Los Angeles, CA, USA, [2]Department of Rehabilitation Medicine, University of Washington, Seattle, WA, USA, [3]Division of Plastic and Reconstructive Surgery, University of Southern California, Los Angeles, CA, USA,[4]Department of Psychiatry and the Behavioral Sciences, University of Southern California, Los Angeles, CA, USA, [5]Department of Surgery, The University of Texas Southwestern Medical Center, Dallas, TX, USA, [6]Department of Surgery, University of Washington, Seattle, WA, USA, [7]Department of Physical Medicine and Rehabilitation, Harvard Medical School, Spaulding Rehabilitation Hospital, Boston, MA, USA

Introduction

- Burns continue to be one of the leading causes of trauma morbidity and mortality for pediatric patients [1,2]
- Amputation after burn injury may be necessary, but can cause physical disability and disfigurement[3,4,5]
- For adults, post-burn amputation was found to be negatively correlated with mental health scores and positively correlated with physical function scores long-term[6]

Objectives

- To study the longitudinal problems in recovery faced by pediatric post-burn amputees in both physical function and self appearance
- To highlight ways to improve in-hospitalization and post-discharge care so these patients can attain maximal functional and psychosocial recovery

Materials and Methods

- Burn Model System (BMS) National Database – a prospective, longitudinal, multicenter database funded by the National Institute on Disability, Independent Living, and Rehabilitation Research
- Inclusion: Pediatric (<18 years old) participants who sustained burns after 2014 and had at least one outcomes measure
- Exclusion: Non-consentable participants, adults, participants not listed alive at hospital discharge, and participants without post-burn amputation data

Study Variables	
Patient Demographics	Age, sex, race, ethnicity
Burn Injury Characteristics	Burn etiology, % total burn surface area (TBSA), burn location, post-burn amputation status and location
	Patient-Reported Outcomes Collected at 6-, 12-, and 24 Months Post-Burn
Patient-Reported Outcomes Measurement Information System (PROMIS) Pediatric-25 Profile v2.0 Physical Function Mobility	Questionnaire comprising of 6 four-item forms measuring 6 domains: anxiety, depression, fatigue, pain interference, peer relationships, and physical function mobility Higher scores → greater intensity for domain measured
Children Burn Outcomes Questionnaire for ages 11 to 18 ($BOQ_{11\text{-}18}$) Appearance Sub-score	Questionnaire assessing physical, social, and psychological outcomes among pediatric burn patients Appearance sub-score assesses feelings of unattractiveness and discomfort in social interactions Lower scores→ greater feelings of unattractiveness and discomfort

- Amputees were matched at a 1:1 ratio to non-amputees, exactly by burn location and nearest neighbor by age and % TBSA
- Outcomes scores between groups at each timepoint were compared (pairwise analysis)
- Differences in outcomes between groups were compared, while accounting for correlations between pairs and adjusting for time of measurement (linear mixed-effects model)
- Two-sided significance level of 0.05 was used

Results

Table 1. Demographic and burn injury characteristics for matched pairs

	Amputation	No Amputation
Age; mean (SD=standard deviation)	12.5 (3.1)	13.1 (2.8)
Age range	8-17	9-17
Sex; n (%)		
Male	11 (64.7)	12 (70.6)
Female	6 (35.3)	5 (29.4)
Race; n (%)		
African-American/Black	0 (0)	1 (5.9)
White	3 (17.6)	8 (47.1)
Other race	6 (35.3)	6 (35.3)
Unknown	8 (47.1)	2 (11.8)
Ethnicity; n (%)		
Hispanic, Latino, or Spanish origin	14 (82.4)	8 (47.1)
Not Hispanic, Latino, or Spanish origin	2 (11.8)	9 (52.9)
Unknown	1 (5.9)	0 (0)
Etiology; n (%)		
Fire/Flame	8 (47.1)	12 (70.6)
Grease	0 (0)	1 (5.9)
Electricity	9 (52.9)	2 (11.8)
Flash burn	0 (0)	2 (11.8)
% TBSA; mean (SD)	44.1 (21.1)	44.9 (25)
Head burn; n (%)		
Yes	10 (58.8)	11 (64.7)
No	7 (41.2)	6 (35.3)
Trunk burn; n (%)		
Yes	15 (88.2)	14 (82.4)
No	2 (11.8)	3 (17.6)
Perineum burn; n (%)		
Yes	9 (52.9)	9 (52.9)
No	8 (47.1)	8 (47.1)
Upper extremity burn; n (%)		
Yes	17 (100.0)	17 (100.0)
Lower extremity burn; n (%)		
Yes	3 (17.6)	4 (23.5)
No	14 (82.4)	13 (76.5)
Upper amputation only; n (%)		
Yes	7 (41.2)	NA
Lower amputation only; n (%)		
Yes	1 (5.9)	NA
Upper and lower amputation; n (%)		
Yes	2 (11.8)	NA
Unknown amputation location; n (%)		
Yes	7 (41.2)	NA

Table 2. Mean and standard deviations of the PROMIS Physical Function T-scores at each post-burn timepoint stratified by occurrence of amputation

	Amputation	No Amputation	p-value
PROMIS Physical Function T-score; mean (SD=standard deviation)			
Month 6	50.2 (15.3)	59.1 (8.9)	0.094
Month 12	53.2 (12.4)	61.3 (10.7)	0.081
Month 24	54.9 (11.6)	66 (5)	0.013*

*Significant according to two-sided significance level of 0.05

Table 3. Results from linear mixed-effects model assessing the impact of amputation on PROMIS Physical Function T-scores at each post-burn timepoint

	Coefficient	p-value	Coefficient	p-value
Intercept	59.0	0.000	59.2	0.000
Time				
12 Months	3.2	0.165	1.9	0.554
24 Months	7.1	0.006	8.5	0.026
Amputee	-9.3	0.006	-9.7	0.023
Time:Amputee Interaction (p-value=0.608)				
12 Months:Amputee	NA	NA	2.4	0.603
24 Months:Amputee	NA	NA	-2.3	0.659

Table 4. Mean and standard deviations of the appearance subscale scores of the Children Burn Outcomes Questionnaire at each post-burn timepoint stratified by occurrence of amputation

	Amputation	No Amputation	p-value
Children Burn Outcomes Questionnaire: Appearance Score; mean (SD=standard deviation)			
Month 6	14.7 (5.9)	14.8 (4.3)	0.948
Month 12	11.6 (6.4)	15.7 (5.1)	0.076
Month 24	12.9 (6.1)	15.1 (3.4)	0.329

*Significant according to two-sided significance level of 0.05

Table 5. Results from linear mixed-effects model assessing the impact of amputation on the appearance subscale score of the Children Burn Outcomes Questionnaire at each post-burn timepoint

	Coefficient	p-value	Coefficient	p-value
Intercept	15.2	0.000	14.1	0.000
Time				
12 Months	-0.3	0.769	1.9	0.206
24 Months	0.0	0.997	1.4	0.432
Amputee	-2.8	0.090	-0.4	0.843
Time:Amputee Interaction (p-value=0.098)				
12 Months:Amputee	NA	NA	-4.6	0.039
24 Months:Amputee	NA	NA	-3.0	0.220

Discussion

- Post-burn amputation was significantly associated with worse physical function but not self appearance among pediatric burn participants
- Our study suggests that, compared to adults, pediatric patients may be able to better psychosocially adjust to injury-related alterations in appearance, which is supported by other studies[7,8]
- Majority of the amputees in this study had electrical burns, which are associated with worse physical functioning due to greater risk of injury complications[3,9]
- Pediatric patients with serious burns resulting in pain and mobility restrictions may have unimpacted psychological well-being after amputation, which may have partially alleviated pain and enhanced functional mobility
- This study can guide recommendations for physical therapy, occupational therapy, and early amputee-specific rehabilitative interventions → to improve physical function, any prosthesis usage, and overall functional independence

Limitations

- Data are not representative of a national sample
- Majority of the participants were from Mexico and have worse burns than the US population
- Long-term data obtained via self-reported surveys are subject to both recall and response bias

Future Directions

- Investigate coping strategies employed by pediatric burn amputees that may be contributing to psychological resilience and adaptability
- Compare outcomes by pediatric age sub-groups (children vs. adolescent) and between amputees with different amputation locations

Funding

The contents of this manuscript were developed under a grant from the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR grant numbers 90DPGE0004, 90DPBU0005, 90DPBU0007, and 90DPBU0008). NIDILRR is a Center within the Administration for Community Living (ACL), Department of Health and Human Services (HHS). The contents of this abstract do not necessarily represent the policy of NIDILRR, ACL, or HHS, and you should not assume endorsement by the Federal Government.

References

1. Guldogan CE, Kendirci M, Gundogdu E, Yasti AC. Analysis of factors associated with mortality in major burn patients. Turk J Surg. Sep 2019;35(3):155-164. doi:10.5578/turkjsurg.4065
2. Partain KP, Fabia R, Thakkar RK. Pediatric burn care: new techniques and outcomes. Curr Opin Pediatr. Jun 2020;32(3):405-410. doi:10.1097/MOP.0000000000000902
3. Bartley CN, Atwell K, Purcell L, Cairns B, Charles A. Amputation Following Burn Injury. J Burn Care Res. Jun 21 2019;40(4):430-436. doi:10.1093/jbcr/irz034
4. Desmond DM. Coping, affective distress, and psychosocial adjustment among people with traumatic upper limb amputations. J Psychosom Res. Jan 2007;62(1):15-21. doi:10.1016/j.jpsychores.2006.07.027
5. Rosca AC, Baciu CC, Burtaverde V, Mateizer A. Psychological Consequences in Patients With Amputation of a Limb. An Interpretative-Phenomenological Analysis. Front Psychol. 2021;12:537493. doi:10.3389/fpsyg.2021.537493
6. Carrougher GJ, McMullen K, Mandell SP, et al. Impact of Burn-Related Amputations on Return to Work: Findings From the Burn Injury Model System National Database. J Burn Care Res. Jan 1 2019;40(1):21-28. doi:10.1093/jbcr/iry057
7. Rifkin WJ, Kantar RS, Ali-Khan S, et al. Facial Disfigurement and Identity: A Review of the Literature and Implications for Facial Transplantation. AMA J Ethics. Apr 1 2018;20(4):309-323. doi:10.1001/journalofethics.2018.20.4.peer1-1804
8. King ICC. Body image in paediatric burns: a review. Burns Trauma. 2018;6:12. doi:10.1186/s41038-018-0114-3
9. Gil S, Fernandez-Pineda I, Rao B, et al. Role of Amputation in Improving Mobility, Pain Outcomes, and Emotional and Psychological Well-Being in Children With Metastatic Osteosarcoma. Am J Hosp Palliat Care. Feb 2019;36(2):105-110. doi:10.1177/1049909118791119