CENTER FOR HEALTHCARE ENGINEERING & PATIENT SAFETY
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Evaluating Fire and Burn Risk Posed by Fiberoptic Cords

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Introduction

Fiberoptic cords (FOCs) can cause surgical fires, posing significant risk to patients and providers in the operating room (OR). FOCs are used to transmit light in minimally-invasive endoscopic surgeries. Several different light sources and cords are currently used at Michigan Medicine. The Hospital has clear fire safety protocols requiring FOCs to be put into standby mode and placed in holsters when disconnected. However, these protocols are not consistently followed. No protocol currently exists regarding the intensity at which light sources are operated which leads to inconsistencies in how clinicians mitigate fire risk. **Our goal was to assess the fire risk posed by commonly used FOCs and to evaluate the Stryker Safelight system, which has additional safety features that force the light source into standby when the adapter is disconnected.**

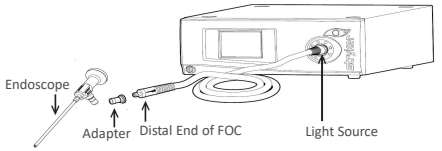

Figure 1: Stryker Safelight System

Methods

(1) Temperature Profiling

- The temperature probe was placed at the distal end light tip (Figure 2) and on the outside barrel (Figure 3)
- Temperatures were recorded every 20s for 8 minutes
- Cool-down temperatures were recorded until constant for 1 min
- For the Stryker Safelight system, the adapter was used to permit testing (without the adapter, the system automatically shuts off)

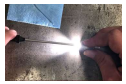

Figure 2

Figure 3

(2) Drape Burn Testing

- The cord was allowed to heat up for 8 minutes at 100% light intensity
- The distal end was held perpendicular to the drape for 10 seconds
- The process was repeated with the light source at 30% and 50% light intensity
- A photo of the drape was captured

(3) Chicken Burn Testing

- The cord was allowed to heat up for 8 minutes at 100% light intensity
- The drape was placed directly over a raw chicken thigh or with a cotton towel piece between the chicken and drape
- The light tip was held directly over the drape for 5 minutes
- A photo of the drape, towel and chicken was captured at 30s, 2 min, and 5 min
- The process was repeated with the light source at 30% and 50% light intensity

Results

(1) Temperature Profiling

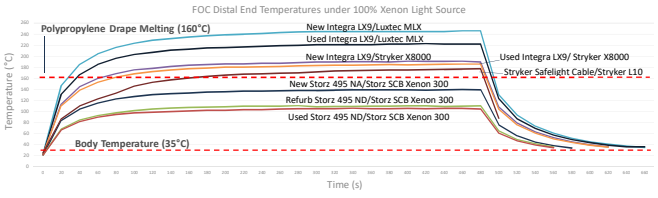

Figure 4: The new Integra LX9 cord reached the maximum temperature of 246°C (474.8°F). Five of the eight cords tested reached temperatures above the melting temperature of polypropylene drapes.

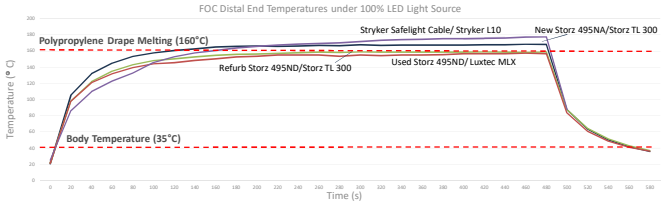

Figure 5: The Stryker Safelight cable reached the maximum temperature of 177.1°C (350.8°F). Three of the four cords tested reached temperature above the melting temperature of polypropylene drapes.

(1) Temperature Profiling

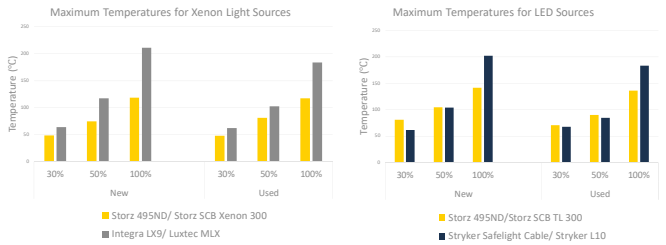

Figure 6: Maximum temperature of the light tip increases as the light intensity increases. All cord and system combinations pose a significant burn risk when operated at 100% intensity.

(2) Drape Burn Testing

Storz 300W SCB with Storz 495ND Cords | *Luxtec MLX 300W with Integra Cords* | *Stryker Safelight with Safelight Cords*

Figure 7: At 100% light intensity, all source and cord combinations melted the surgical drape within 10 seconds. No cords operated 30% light intensity melted a hole in the surgical drape

(3) Chicken Burn Testing

Figure 8A: Every system and cord combination caused chicken burns after 30s at **100%** light intensity through drape only. Only the Integra cords caused chicken burns at **50%** light intensity. No combination caused burns at **30%** light intensity.
Figure 8B: Only the Integra cords caused slight chicken burns through the drape AND towel.

Storz 495ND

Light Source	Cord	Intensity	Towel?	Hole in Drape?	Towel Burn?	Chicken Burn?
Storz SCB (300W LED)	NEW	100%	Y	✓		
			N	✓		✓
		50%	Y	✓		
			N	✓		✓
	USED	100%	Y	✓	✓	
			N	✓		✓
		50%	Y	✓		
			N	✓		
Storz SCB (300W Xenon)	NEW	100%	Y	✓		
			N	✓		✓
		50%	Y	✓		
			N	✓		
	USED	100%	Y	✓	✓	
			N	✓		✓
		50%	Y	✓		
			N	✓		

Stryker Safelight

Light Source	Cord	Intensity	Towel?	Hole in Drape?	Towel Burn?	Chicken Burn?
Stryker Safelight (300W LED)	NEW	100%	Y	✓		
			N	✓		✓
		50%	Y			
			N			
	USED	100%	Y	✓		
			N	✓		✓
		50%	Y			
			N			
Integra						
Luxtec MLX (300W Xenon)	NEW	100%	Y	✓	✓	✓
			N	✓		✓
		50%	Y	✓		
			N	✓		✓
	USED	100%	Y	✓	✓	✓
			N	✓		✓
		50%	Y	✓		
			N	✓		✓

Table 1: Qualitative results of chicken burn testing

Conclusions

- Fiberoptic light cords and sources pose burn risks at 100% light intensity
- Burns result from radiation and conduction at the cord's distal end
- The Stryker Safelight enters standby mode immediately after adapter detachment
- This risk reduction is automatic, does not depend upon operator diligence, and significantly reduces burn risk by eliminating heat from light radiation
- Operation of fiberoptic light cords and sources at lower light intensities also significantly decreases patient burn risk, but requires operator compliance

Recommendations

- Conduct a cost-benefit analysis of the Stryker Safelight system
- Perform testing to determine minimum light intensity needed for safe surgical operation
- Establish OR light intensity guidelines and physically modify the light sources to prevent this intensity from being exceeded
- Enforce standby safety protocols in the operating room

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