

## Fleksibl Endoskoplarda

# HPGP & Hdrozone (Hidronyum Ağır Molekül) Sterilizasyon Yöntemine

## İlişkin Teknik Sonuç Değerlendirmesi

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### KONU

Fleksibl endoskoplardan malzeme yapısı dikkate alınarak  $VH_2O_2$ , HPGP ve Hdrozone sterilizasyon yaklaşımının teknik uygunluğunu, riskli bölgelerini ve sonuç değerlendirmesini yapmak

Değerlendirme şu temel yapı üzerinden yapılmıştır:

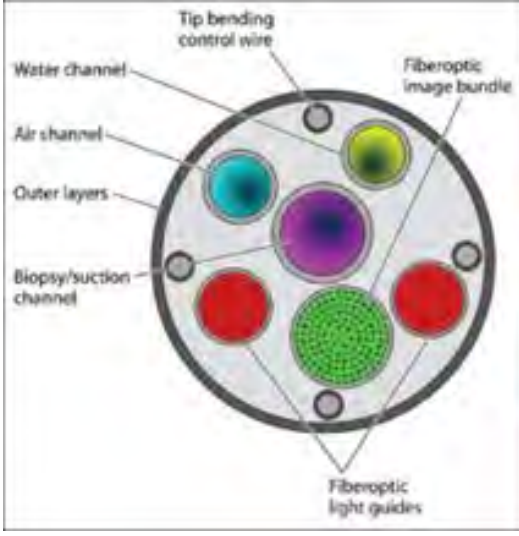
- Endoskop malzeme yapısı
- Sterilizasyonda kritik yüzeyler
- Lümen içi sterilizasyon gerekliliği
- Polimer, elastomer, metal ve optik bileşen davranışı
- Hdrozone açısından uygunluk ve risk değerlendirmesi



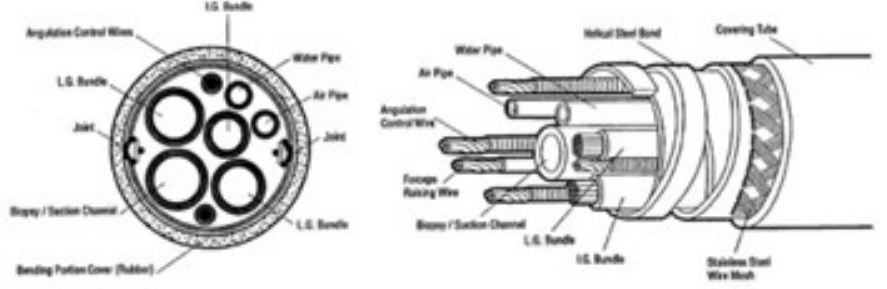
### KEYLER

HPGP,  $VH_2O_2$ , Hidronyum, Enfiltrasyon, Difüzyon, Kondensasyon, Hibrit, Distal

# 1. ENDOSKOP STERİLİZASYONUNDA PROBLEM NEDİR?



## ENDOSCOPE CROSS SECTION

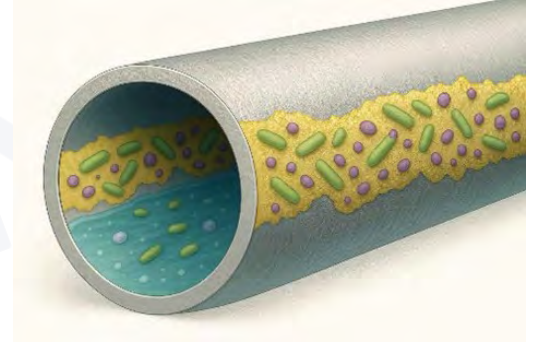


Fleksibl endoskop sterilizasyonunda temel problem, cihazın tek parça ve homojen bir malzemeden oluşmamasıdır.

Bir fleksibl endoskop:

- Dış kılıf
- İç spiral yapı
- Bükülebilir distal uç
- Lümen / çalışma kanalı
- Optik sistem
- Kontrol kabloları
- Yapıştırıcı ve bağlantı elemanları içeren çok katmanlı hibrit bir medikal cihazdır.

Bu yapı nedeniyle sterilizasyon sadece dış yüzey problemi değildir.



## 1.1 H<sub>2</sub>O<sub>2</sub> (VH<sub>2</sub>O<sub>2</sub>), HPGP Sterilizasyon Yönteminin Bu Problemlere Yaklaşımı

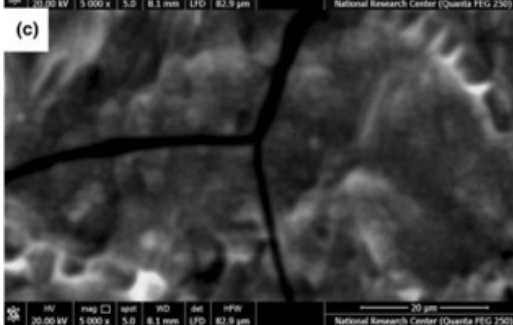
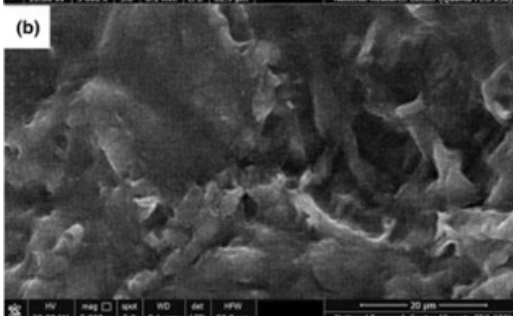
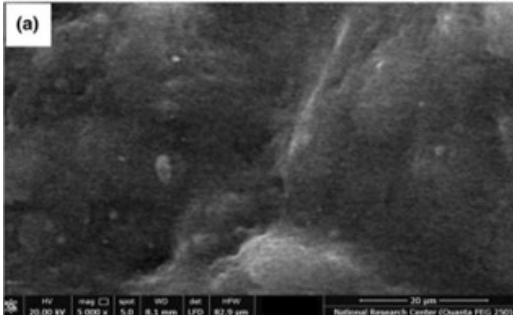
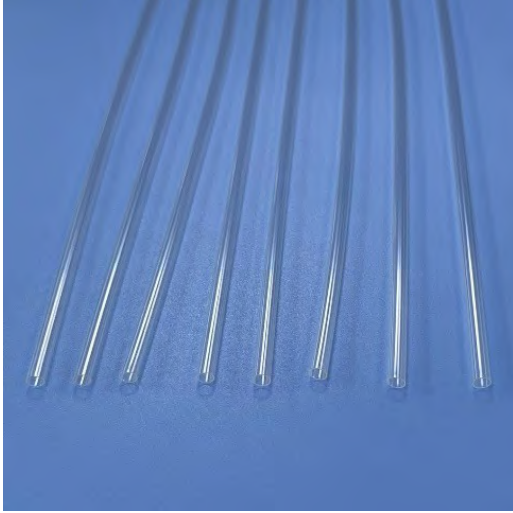
- Buhar faz hidrojen peroksit yüzeyde yüksek oksidatif etki oluşturur
- Penetrasyon, difüzyon ve kondensasyon mekanizmasına bağlıdır
- Lümen içinde reaktif kaybı oluşabilir
- Biyofilm üzerinde etkinlik, yüzey erişimine bağlıdır

### SONUÇ:

H<sub>2</sub>O<sub>2</sub> sistemleri yüzey sterilizasyonunda güçlü, ancak uzun ve dar lümenlerde sınırlı etkinlik gösterir.

## 2. ENDOSKOPLARDA MALZEME BAZLI TEMEL PROBLEMİN TANIMI

### 2.1 Dış Kılıf



Kullanılan malzemeler:

- TPU
- Silikon elastomer
- Pebax

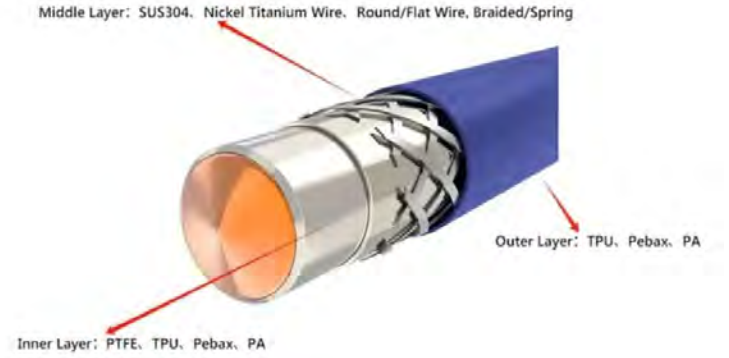
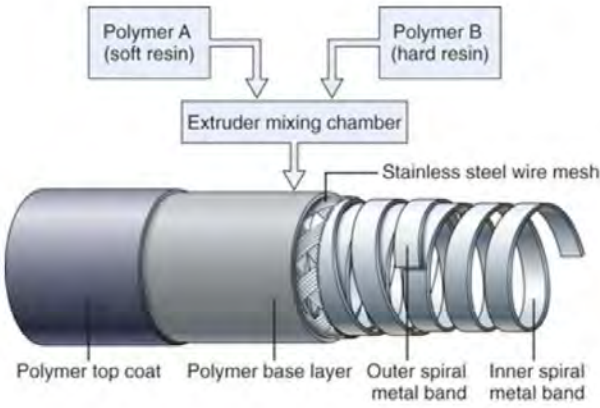
**SONUÇ:**

**Dış kılıf, sterilizasyon hasarı açısından birinci kritik bölgedir.**

**H<sub>2</sub>O<sub>2</sub> vs Hdrozone**

- H<sub>2</sub>O<sub>2</sub>:
  - Yüksek oksidatif yoğunluk, yüzey hasar riski
- Hdrozone:
  - Kontrollü oksidan dağılımı, düşük sıcaklık avantajı

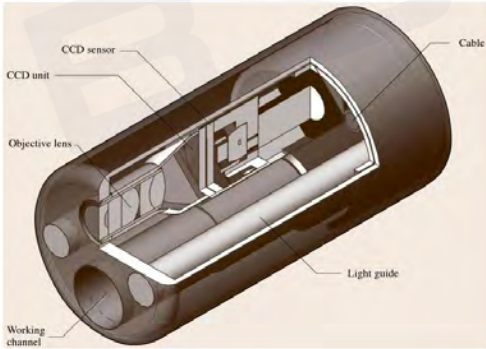
## 2.2 Endoskoplarda İç Spiral / Örgü Yapı



SONUÇ:

**Metal taşıyıcı yapı, Hdrozone ve H<sub>2</sub>O<sub>2</sub> açısından düşük riskli bölgedir.**

## 2.3 Distal Bükülebilir Uç



SONUÇ:

**Distal uç, kimyasal ve mekanik stresin birleştiği yüksek riskli bölgedir.**

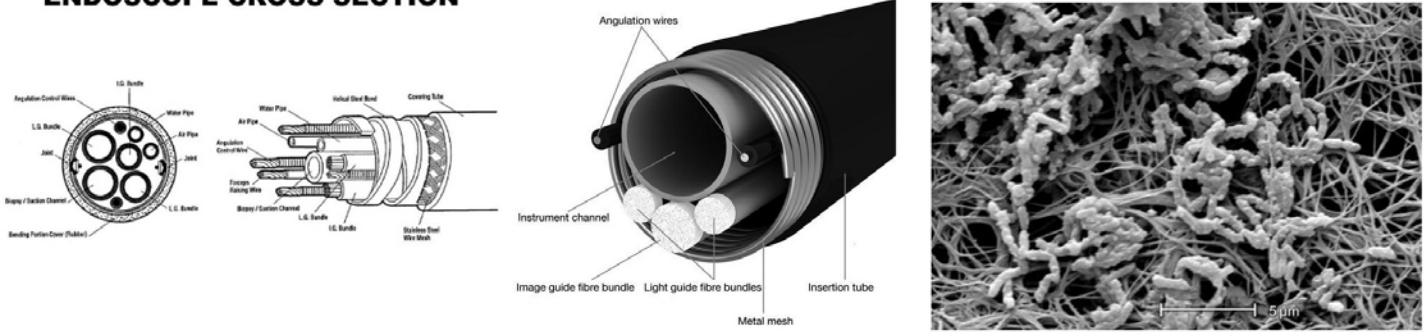
### H<sub>2</sub>O<sub>2</sub> vs Hdrozone

- H<sub>2</sub>O<sub>2</sub>: Kondensasyon ve lokal yoğunluk artışı olabilir
- Hdrozone: Gaz faz dağılımı daha homojen



## 2.4 Endoskoplarda Lümen / Çalışma Kanalı

### ENDOSCOPE CROSS SECTION



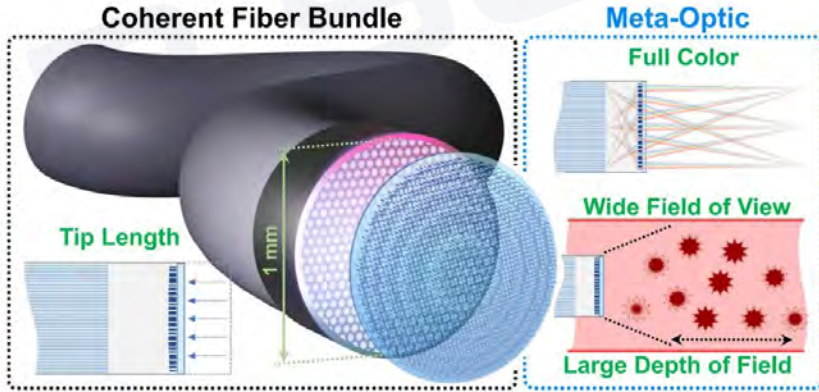
### SONUÇ:

**Sterilizasyon başarısının ana göstergesi lümen iç yüzey etkinliğidir.**

### H<sub>2</sub>O<sub>2</sub> vs Hdrozone

- H<sub>2</sub>O<sub>2</sub>: Difüzyon ve buharlaşma limitlidir
- Hdrozone: Gaz faz + reaktif üretim avantajı

## 2.5 Optik Sistem



### Cross Section Of Fiber Optic Cable



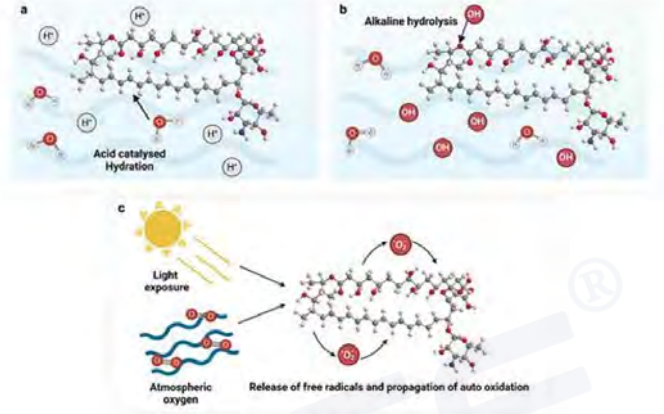
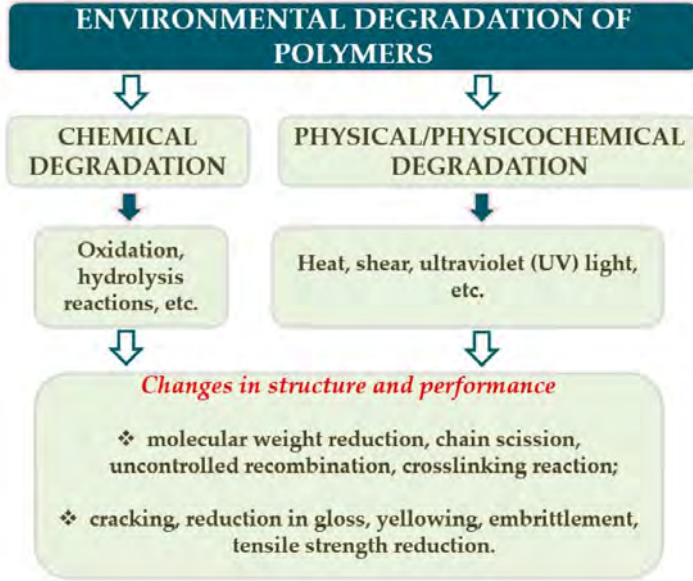
### SONUÇ:

**Endeskoklarda optik cam düşük riskli, epoksi bağlantılar yüksek risklidir.**

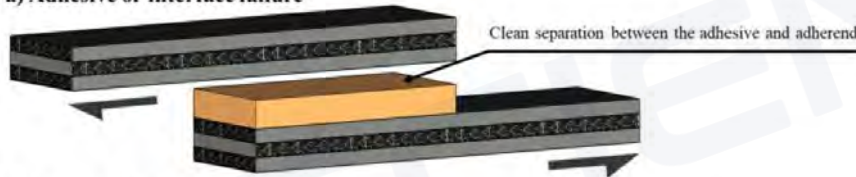
### H<sub>2</sub>O<sub>2</sub> vs Hdrozone

- H<sub>2</sub>O<sub>2</sub>: Epoksi üzerinde oksidatif stres
- Hdrozone: Düşük sıcaklık avantajı

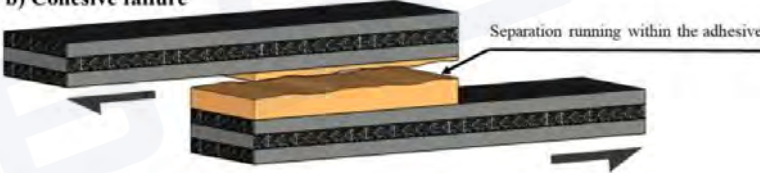
## 2.6 Endoskoplarda Bağlayıcılar ve Yapıştırıcılar



a) Adhesive or interface failure



b) Cohesive failure



c) Substrate or adherend failure



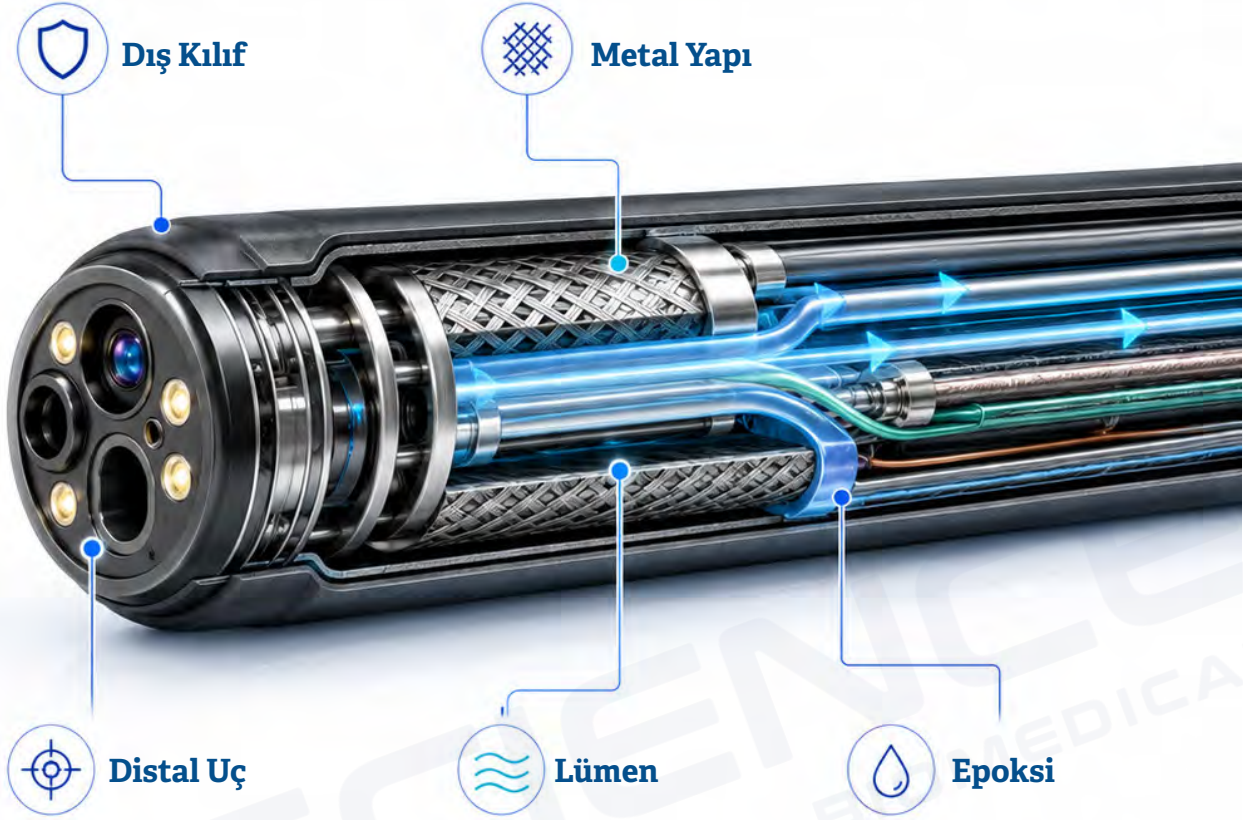
**SONUÇ:**

**Endoskoplarda epoksi ve yapıştırıcılar en kritik zayıf noktalardandır.**

### H<sub>2</sub>O<sub>2</sub> vs Hdrozone

- H<sub>2</sub>O<sub>2</sub>: Yoğun oksidatif etki
- Hdrozone: Kontrollü kimyasal etki

## H<sub>2</sub>O<sub>2</sub> VS. VE HDROZONE AÇISINDAN ENDOSKOP STERİLİZASYONUNDA TEKNİK UYGUNLUK DEĞERLENDİRMESİ



BÖLGE	H <sub>2</sub> O <sub>2</sub>	HDROZONE
Dış Kılıf	Orta-Yüksek Risk	Orta Risk
Metal Yapı	Düşük Risk	Düşük Risk
Distal Uç	Yüksek Risk	Orta-Yüksek
Lümen	Sınırlı	Daha Yüksek Potansiyel
Epoksi	Yüksek Risk	Orta Risk

Hidrozone için belirleyici konu:

- Lümen İç Yüzeyi
- Distal Uç
- Biyofilm Bölgeleri

### Karşılaştırmalı Sonuç

- H<sub>2</sub>O<sub>2</sub>: Yüzey dominant sterilizasyon
- Hidrozone: Lümen odaklı sterilizasyon yaklaşımı

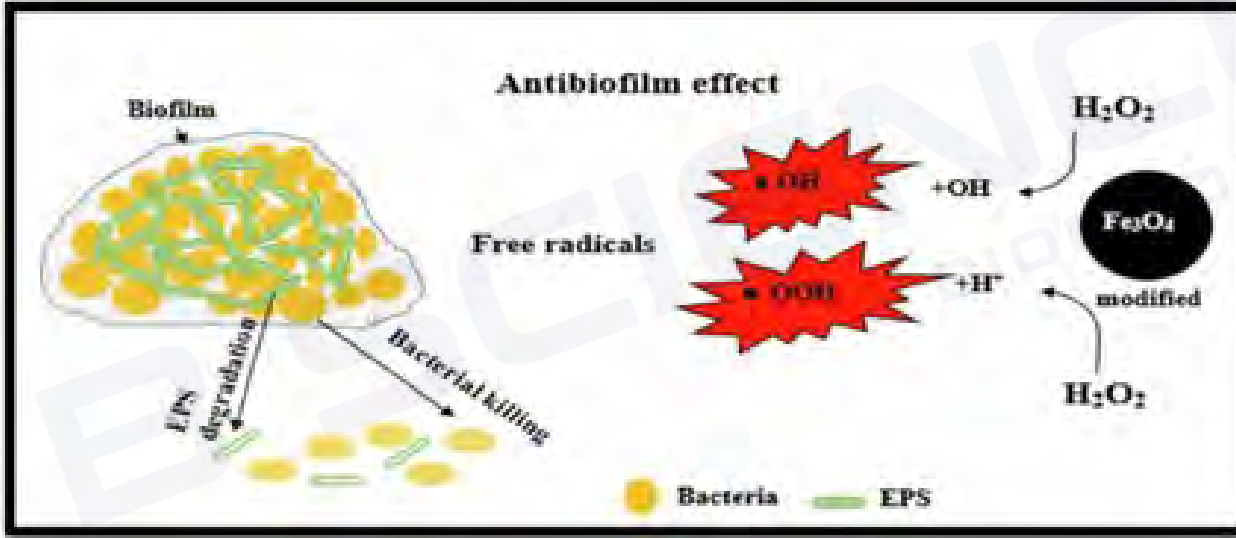


## ENDOSKOPLARDA MALZEME HASARI AÇISINDAN KARŞILAŞTIRMA

### Karşılaştırma

- H<sub>2</sub>O<sub>2</sub>: Yüksek oksidatif yoğunluk
- Hdrozone: Daha dengeli oksidan dağılımı

## ENDOSKOPLARDA H<sub>2</sub>O<sub>2</sub> VS. VE HDROZONE'NUN STERİLİZASYONDA ETKİNLİĞİNİN KARŞILAŞTIRILMASI



- H<sub>2</sub>O<sub>2</sub>: Yüzey etkisi güçlü, penetrasyon potansiyeli düşük
- Hdrozone: Yüzey etkisi güçlü, penetrasyon potansiyeli yüksek

## STERİLİZASYONDA ULTRA DÜŞÜK SICAKLIK ETKİSİ

- H<sub>2</sub>O<sub>2</sub>: 45-55 °C genelde düşük sıcaklık ama lokal ısınma olabilir
- Hdrozone: 37-42 °C kontrollü ultra düşük sıcaklık

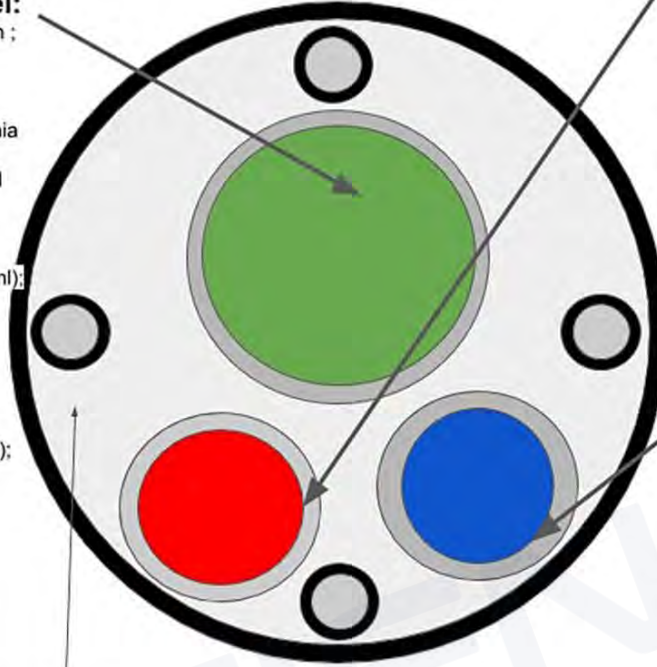


## ENDOSKOPLARDA STERİLİZASYONUN LÜMEN ETKİ KARŞILAŞTIRMASI

### Biopsy / Suction Channel:

Aspergillus Spp; Bacillus megaterium ;  
Bacillus simplex (1 CFU/20ml) ;  
Brevibacterium casei ;  
Candida albicans (69 CFU/15ml) ;  
Carbapenemase Klebsiella pneumonia  
(KPC) ;  
Coagulase-negative Staphylococci (1  
Cfu);  
Enterobacter aerogenes(5 CFU) ;  
Klebsiella oxytoca (7 CFU/ml) ;  
Klebsiella pneumonia (300CFU/100ml);  
Lactococcus Lactis Ssp. Lactis ;  
Micrococcus luteus (2 CFU/20ml) ;  
Multidrug-resistant Pseudomonas  
aeruginosa ;  
Neisseria Spp. ;  
Ochrobactrum anthropi ;  
Pseudomonas aeruginosa (100 CFU);  
Pseudomonas putida;  
Rhizobium radiobacter ;  
Sphingomonas Sp;  
Staphylococcus aureus;  
Staphylococcus capitis ;  
Staphylococcus haemolyticus;  
Staphylococcus warneri;  
Stenotrophomonas maltophilia  
(100CFU);  
Streptococcus mitis ;  
Streptococcus oralis

Tip Bending  
Control Wire



### Instrument Channel:

Acinetobacter calcoaceticus-baumannii ;  
Bacillus subtilis;  
Enterobacter cloacae (>1000 CFU/ml) ;  
Enterococcus faecium ;  
Escherichia coli (>1000 CFU/ml);  
Klebsiella pneumonia (300CFU/100ml) ;  
Kocuria kristinae;  
Neisseria flavescens ;  
Pseudomonas aeruginosa (49CFU - >100 CFU) ;  
Pseudomonas putida;  
Sphingomonas paucimobilis (>100 CFU / 100 ml);  
Staphylococcus epidermidis (40 CFU) ;  
Stenotrophomonas maltophilia (>100  
CFU/endscope) ;  
Staphylococcus pasteuri ;  
Staphylococcus warneri

### Air/Water Channel

Bacillus Spp (2,070CUF/ml);  
Bacillus subtilis;  
Coagulase Negative Staph (16CFU/100ml) ;  
Escherichia coli (>1000 CFU/ml);  
Micrococcus luteus (2 CFU/20ml) ;  
Moraxella spp (1CFU) ;  
Neisseria subflava ;  
Pseudomonas aeruginosa (49CFU - >100 CFU) ;  
Rothia dentocariosa ;  
Sphingomonas Sp ;  
Staphylococcus epidermidis (40 CFU) ;  
Staphylococcus warneri ;  
Streptococcus salivarius (3 CFU)

## Lümen Sterilizasyonu Karşılaştırması

- H<sub>2</sub>O<sub>2</sub>: Uzun lümenlerde sınırlı, 1,5 m etkin
- Hdrozone: Gaz faz avantajı, 15 m'ye kadar etkin

## ENDOSKOP STERİLİZASYONUNDA H<sub>2</sub>O<sub>2</sub> VS. İLE HDROZONE'NUN KARŞILAŞTIRMALI GENEL SONUÇ DEĞERLENDİRMESİ

### Her İki Sterilizasyon Yönteminin Güçlü Yönleri

#### H<sub>2</sub>O<sub>2</sub>:

- Güçlü yüzey sterilizasyonu
- Yaygın kullanım

#### Hdrozone:

- Düşük sıcaklık
- Gaz faz penetrasyonu
- Lümen avantajı

## Her İki Sterilizasyon Yönteminde Kritik Riskleri

### H<sub>2</sub>O<sub>2</sub>:

- Epoksi hasarı
- Yüzey aşırı oksidasyon

### Hidrozone:

- Proses kontrolünde dikkatli olunması,

## SONUÇ

- H<sub>2</sub>O<sub>2</sub>: Yüzey odaklı yoğunlaşmadan dolayı lümen etkinliği sınırlı
- Hidrozone: Hibrit hidronyum sterilizasyon yönteminden dolayı uzun lümen odaklı

Fleksibl endoskop sterilizasyonunda ise

- H<sub>2</sub>O<sub>2</sub> sistemleri yüzey sterilizasyonunda güçlüdür
- Hidrozone sistemleri hem yüzey sterilizasyonunda hemde uzun lümen penetrasyonu açısından yüksek teknik avantaj sunar.

**Hidrozone, fleksibl endoskop sterilizasyonunda H<sub>2</sub>O<sub>2</sub> sistemlerine göre özellikle lümen penetrasyonu ve düşük sıcaklık uyumu açısından avantaj sağlayan bir hibrit ağır molekül sterilizasyon yöntemidir. Uzun lümenli malzeme ve karmaşık endoskop sterilizasyonunda problem çözücü niteliğe sahiptir.**

## KAYNAKÇA

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