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# THE ENDOCKSCOPE: A DISRUPTIVE ENDOSCOPIC TECHNOLOGY

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## INTRODUCTION

The Endockscope (ES) combines a smartphone, lens system, and rechargeable LED light source to provide a low-cost alternative ($45) to the standard camera and high-power light source ($45,000) used in endoscopic procedures. We compared the performance of the ES to the standard high-power light source and camera viewing system using a broad range of rigid/semi-rigid endoscopes in a male cadaver.

## METHODS

- Standard endoscopy was performed using one of four rigid or semi-rigid Karl Storz endoscopes with one of three cameras:
  - Rigid Cystoscope
  - Rigid Nephroscope
  - Semi-rigid Ureteroscope
  - 30˚ Laparoscope
  - ES plus Apple iPhone X
  - ES plus Samsung Galaxy S9+
  - Karl Storz HD camera + high power light source
- Short (<20 sec) videos were recorded in an adult male cadaver.
- 12 faculty and 4 residents at UC Irvine were blinded to the camera modality type and assessed the images in five areas using a 1-5 Likert scale (1=poor, 5=excellent):
  - Image Resolution
  - Brightness
  - Color Quality
  - Sharpness
  - Overall Image Quality
- 12 faculty and 4 residents also provided a binary “yes or no” evaluation of the obtained images regarding their acceptability for diagnostic use.

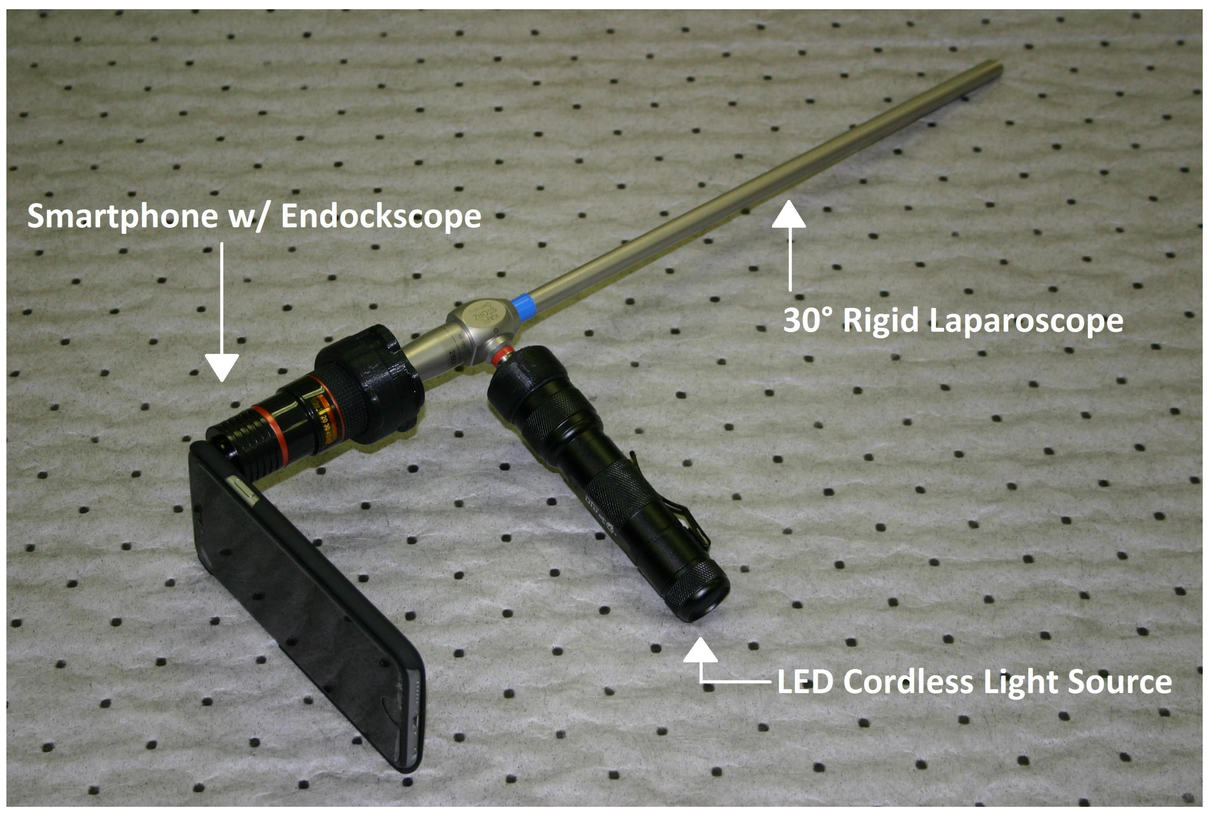


**Figure 1.** Assembled Endockscope System with a Laparoscope

## RESULTS

**Table 1.** Reviewers’ Evaluation with Rigid/Semi-Rigid Endoscopes

| | Resolution | Brightness | Color | Sharpness | Overall Image Quality | Acceptability for Diagnosis |
|---|---|---|---|---|---|---|
| **Rigid Cystoscope** | | | | | | |
| **iPhone X** | 3.13±0.64 (p=0.34) | 3.47±0.92 (p=0.19) | 3.47±0.92 (p=0.30) | 3.00±0.76 (p=0.14) | 3.27±0.88 (p=0.41) | 80% |
| **Galaxy S9+** | 3.60±0.83 (p=0.17) | 3.53±0.74 (p=0.23) | 3.40±0.83 (p=0.36) | 3.33±0.82 (p=0.50) | 3.40±0.83 (p=0.41) | 67% |
| **Standard** | 3.27±1.03 | 3.73±0.70 | 3.29±0.91 | 3.33±0.90 | 3.33±0.72 | 80% |
| **Rigid Nephroscope** | | | | | | |
| | Resolution | Brightness | Color | Sharpness | Overall Image Quality | Acceptability for Diagnosis |
| **iPhone X** | 3.88±0.62 (p=0.19) | 3.88±0.81 (p=0.12) | 3.69±0.60 (p=0.07) | 3.56±0.73 **(p=0.03)** | 3.59±0.61 **(p=0.02)** | 94% |
| **Galaxy S9+** | 3.88±0.81 (p=0.23) | 3.69±0.70 **(p=0.02)** | 3.63±0.89 (p=0.07) | 3.67±0.82 (p=0.09) | 3.86±0.81 (p=0.23) | 88% |
| **Standard** | 4.06±0.57 | 4.20±0.68 | 4.06±0.77 | 4.06±0.77 | 4.05±0.58 | 100% |
| **Semi-Rigid Ureteroscope** | | | | | | |
| | Resolution | Brightness | Color | Sharpness | Overall Image Quality | Acceptability for Diagnosis |
| **iPhone X** | 4.00±0.82 (p=0.46) | 3.94±0.85 (p=0.20) | 4.06±0.93 (p=0.26) | 4.13±0.89 (p=0.17) | 3.95±0.86 (p=0.38) | 81% |
| **Galaxy S9+** | 4.63±0.50 **(p=0.01)** | 4.25±0.68 (p=0.41) | 4.69±0.60 (p=0.08) | 4.63±0.62 **(p=0.004)** | 4.48±0.72 (p=0.07) | 100% |
| **Standard** | 3.97±0.97 | 4.19±0.83 | 4.28±0.97 | 3.80±0.94 | 4.05±0.93 | 88% |
| **30° Laparoscope** | | | | | | |
| | Resolution | Brightness | Color | Sharpness | Overall Image Quality | Acceptability for Diagnosis |
| **iPhone X** | 2.46±1.05 **(p<0.001)** | 2.83±0.72 **(p<0.001)** | 2.77±0.83 **(p<0.001)** | 2.17±0.58 **(p<0.001)** | 2.46±0.88 **(p<0.001)** | 23% |
| **Galaxy S9+** | 3.92±0.90 (p=0.06) | 3.83±0.83 **(p=0.04)** | 3.85±0.90 (p=0.21) | 4.00±1.00 (p=0.12) | 3.85±0.90 **(p=0.047)** | 92% |
| **Standard** | 4.46±0.78 | 4.38±0.65 | 4.15±0.99 | 4.42±0.67 | 4.38±0.65 | 100% |

## CONCLUSION

- **The Endockscope system plus the Samsung Galaxy S9+ offers comparable imaging for rigid endoscopy and provides diagnostic information equivalent to the standard system for rigid endoscopy of the kidney, ureter, bladder, and abdomen.**

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