

Small-caliber endoscopes are more fragile than conventional endoscopes



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submitted 6.8.2019

accepted after revision 7.10.2019

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DOI <https://doi.org/10.1055/a-1036-6186> |
Endoscopy International Open 2019; 07: E1729–E1732
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eISSN 2196-9736

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ABSTRACT

Background and study aims The repair costs of gastrointestinal endoscopes account for a significant proportion of the total budget of an endoscopy unit. This study evaluated the repair costs of small-caliber endoscopes and conventional endoscopes used in esophagogastroduodenoscopy (EGD).

Patients and methods A retrospective analysis of upper gastrointestinal endoscope damage and repair costs between April 2012 and May 2019 was performed at the Toyoshima Endoscopy Clinic. Conventional endoscopes (GIF-H260, GIF-HQ290, and GIF-H290Z) were used for transoral EGD while small-caliber endoscopes (GIF-XP260N and GIF-XP290N) were used for transnasal or transoral EGD.

Results Three small-caliber endoscopes and five conventional endoscopes were used for 1,031 procedures and 31,192 procedures, respectively. The number of procedures/damage incidence for small-caliber endoscope and conventional endoscopes was 344 and 1950, respectively. Damage incidence for small-caliber endoscopes was significantly higher than for conventional endoscopes ($P=0.014$). Repair costs/procedure were $\$5.95 \pm \132 for small-caliber endoscopes and $\$2.41 \pm \115 for conventional endoscopes. Repair costs/procedure for small-caliber endoscopes were more than twice those for conventional endoscopes.

Conclusions Small-caliber endoscopes are more fragile than conventional endoscopes.

Introduction

Esophagogastroduodenoscopy (EGD) is the routine method for investigating the upper digestive system [1–3]. Small-caliber gastrointestinal endoscopes have been developed and marketed and can be inserted transnasally [4, 5]. Transnasal endoscopy is better tolerated, with high levels of patient comfort and acceptability and can be safely performed [6, 7]. However, there are several problems with small-caliber endoscopes. They have technical difficulties due to greater flexibility but limited optical capabilities. Video image resolution is inferior to con-

ventional high-resolution endoscopes. Furthermore, image quality may be impaired when secretions or bubbles are present, as a result of poorer suction and lavage [8].

On the other hand, repair costs and maintenance of gastrointestinal endoscopy equipment represent an important share of the total budget of the endoscopy unit. Gastrointestinal endoscopes are damaged through routine wear and tear during procedures, as well as use of aggressive cleaning and disinfection processes [9]. However, repair costs of small-caliber versus conventional endoscopes have never been evaluated. This

► **Table 1** Repair costs for upper gastrointestinal endoscopes.

	Small-caliber endoscope	Conventional endoscope	P value
Procedures performed	1,031	31,192	–
Endoscopes	GIF-XP260N: 2	GIF-H260: 2	–
(number)	GIF-XP290N: 1	GIF-HQ290: 2	
		GIF-H290Z: 1	
Duration of endoscope use	86 ± 61.5	75.8 ± 42.7	0.816
(mean month ± SD)			
Incidents of damage	3	16	0.014
Procedures/damage incidence	344	1950	
Total repair costs (dollars)	6137	75081	–
Repair costs/procedure	5.95 ± 132	2.41 ± 115	0.396
(mean dollar ± SD)			
SD, standard deviation.			

study evaluated repair costs of small-caliber and conventional endoscopes in EGD.

Patients and methods

A retrospective analysis of upper gastrointestinal endoscope damage and repair costs between April 2012 and May 2019 was performed at Toyoshima Endoscopy Clinic, an outpatient clinic specializing in endoscopy. This study was approved by the Ethical Review Committee of the Hattori Clinic [10]. All clinical investigations were conducted according to the ethical guidelines of the Declaration of Helsinki.

At the time of analysis, the following upper gastrointestinal endoscopes were in use: Olympus GIF-H260, GIF-XP260N, GIF-HQ290, GIF-H290Z, and GIF-XP290N. Data on repair costs were obtained from the archive of the invoices of gastrointestinal endoscope repairs and were then compared to the invoice copies from the service company (Olympus, Tokyo, Japan).

Endoscopic examination

EGD was used to evaluate patients with abdominal pain, gastrointestinal bleeding and iron-deficiency anemia, and those who had undergone screening for cancer, polyps, atrophic gastritis, and physical check-up. EGD was performed for diagnostic (observation and biopsies), not for therapeutic purposes, such as polypectomy. Conventional endoscopes (GIF-H260, GIF-HQ290, and GIF-H290Z) were used for transoral EGD. Before starting, the pharynx of patients was topically anesthetized by gargling with 2% lidocaine hydrochloride viscous solution (Xylocaine Viscous 2%, AstraZeneca Inc., Japan) [11]. Sedation with midazolam and/or pethidine was induced based on the patient's willingness [12,13]. Small-caliber endoscopes (GIF-XP260N and GIF-XP290N) were used for transnasal EGD or transoral EGD. The nasal cavity was prepared by spraying three puffs of 0.05% naphazoline (Nippon Shinyaku Co., Ltd., Kyoto,

Japan), followed by 1 mL of 4% Xylocaine delivered as a fine mist using a mucosal atomization device. Furthermore, 3 mL of Xylocaine Viscous was injected into the nasal cavity. An endoscopic nurse assisted with every procedure. Use of small-caliber endoscopes was based on patient preference and better patient tolerability.

Cleaning and disinfection of endoscopes

High-level disinfection was achieved with an automated endoscope re-processor following manufacturer's instructions with strong acidic electrolyzed water (Kaigen pharma CO., LTD. Osaka, Japan). Both small-caliber and conventional endoscopes were sterilized using an automated endoscope re-processor. All endoscopes were stored in endoscope storage cabinets.

Statistical analysis

We compared incidence of damage and repair costs between small-caliber and conventional endoscopes with use of a Student's *t*-test or Welch's *t*-test or χ -squared test. $P < 0.05$ was considered statistically significant. Data were analyzed using the Stat Mate IV software (ATOMS, Tokyo, Japan).

Results

During the study period, 32,223 EGD procedures were performed. Characteristics of small-caliber and conventional endoscope groups are shown in ► **Table 1**. Three small-caliber endoscopes and five conventional endoscopes were used for 1,031 procedures and 31,192 procedures, respectively. Duration of use for small-caliber and conventional endoscopes was 86 ± 61.5 months and 75.8 ± 42.7 months, respectively. The number of procedures/damage incidence for small-caliber endoscopes and conventional endoscopes was 344 and 1950, respectively. Damage incidence for small-caliber endoscopes was significantly higher than that for conventional endoscopes

► **Table 2** Types of endoscope damage.

Endoscope damage	Small-caliber endoscope		Conventional endoscope	
	Occurrences	Average repair cost/damage (dollars)	Occurrences	Average repair cost/damage (dollars)
Damage to the rubber coat on the distal bending section	2	1356	5	2664
Damage to the scope connector	0		5	6492
Damage to the bending apparatus	1	3425	2	3660
Damage to the external sheath	0		1	4773
Ocular damage	0		1	5407
Water channel damage	0		1	5708
Suction channel damage	0		1	6093

($P=0.014$). Repair costs/procedure for the small-caliber and conventional endoscopes were $\$5.95 \pm \132 and $\$2.41 \pm \115 , respectively. Repair costs/procedure for the small-caliber endoscopes were more than twice those for the conventional endoscope ($P=0.396$).

Types of endoscope damage are shown in ► **Table 2**. The most frequent type of damage was to the rubber coat on the distal bending section.

Discussion

Small-caliber endoscopes had a higher frequency of repair than conventional endoscopes. Repair costs for small-caliber endoscopes could be twice that of conventional endoscopes. To the best of our knowledge, this is the first report about repair costs for small-caliber gastrointestinal endoscopes. Fragility and higher repair costs might have an impact on the management strategy of an endoscopy unit, such as the decision about purchase of small-caliber versus conventional endoscopes.

Repair costs/procedures for small-caliber and conventional endoscopes were $\$5.95 \pm \132 and $\$2.41 \pm \115 , respectively. Repair costs for gastrointestinal endoscopes account for a significant proportion of the total budget of an endoscopy unit. The doctors and staff who handle endoscopes should recognize the expensive repair costs and avoid rough handling.

Damage to the rubber coat on the distal bending section was the most frequent type of damage. Extreme bending during endoscopic procedures puts the distal bending section under great mechanical stress, predisposing it to wear and tear [14]. Wear and tear damages occur not only during procedures but also during cleaning and maintenance. Because small-caliber endoscopes are thin, they break easily.

This study had some limitations. First, it was a retrospective review at a single institution. Second, patients were not randomized to either the thin endoscope group or conventional endoscope group; thus, there were background differences.

Conclusion

In conclusion, small-caliber endoscopes are more fragile than conventional endoscopes.

Competing interests

Dr. Suzukl has received scholarship funds from Daiichi-Sankyo Co. Ltd., EA Pharma Co. Ltd., Otsuka Pharmaceutical Co. Ltd, and Tsumura Co. Ltd. and service honoraria from Astellas Pharm Inc., Astra-Zeneca K.K., Daiichi-Sankyo Co. Ltd., EA Pharma Co. Ltd., Otsuka Pharmaceutical Co. Ltd, Mylan EPD., Takeda Pharmaceutical Co. Ltd, and Tsumura Co. Ltd.

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