The Journal of Laryngology & Otology (2009), ***123***, *453–456.*

doi:10.1017/S0022215108003812

Short Communication

Low cost digital endoscopic photography

G D Barr

Abstract

Introduction: Endoscopic digital photography usually involves expensive and often cumbersome equipment.

Aim: This study aimed to construct a low cost adaptor with which to connect a budget-priced digital camera to a nasal endoscope, in order to enable inexpensive, good quality otology photography.

Method: A method of making an adaptor from a simple plastic bottle top is described, and the photographic technique is outlined.

Results: The adaptor fitted well with commonly used endoscopes, and excellent results were obtained.

Conclusion: High quality digital endoscopic photographs can be obtained using a low cost compact digital camera fitted with a simple adaptor made from a plastic bottle top. Such a method would make digital photography via a rigid endoscope easily affordable worldwide.

Key words: Endoscopy; Photography; Otolaryngology

Introduction

Digital photography has become widely available in recent years, aided by the advent of low cost compact cameras and cheap digital storage media. The quality has improved dramatically compared with still photographs taken from videotaped recordings.[1] However, the systems available for digital endoscopic photography remain expensive and cumbersome.[2] Although adaptors can be found for some cameras,[3] availability is limited, and the lower priced cameras usually do not have adaptor rings.

The aim of this study was primarily to devise a method of obtaining endoscopic otological photographs using a budget-priced digital camera, by making an adaptor which would join camera and endoscope with a union stable enough to enable good quality photography. After assessing several types of commonly available materials, it was decided that a plastic bottle top might make a suitable adaptor. Surprisingly, the blue bottle top of Evian plastic mineral water bottles was found to fit exactly with a Wolf (Richard Wolf, London, UK) rigid nasal endoscope eye piece. Cutting a hole into the bottle top enabled attachment of the camera.

Materials and methods

Making the adaptor

A Nikon Coolpix 4600 4 megapixel camera (Nikon Corporation, Kingston upon Thames, UK) is used. The blue bottle top of an Evian plastic mineral water bottle (Evian, Danone Group, Paris, France) has an inner ring 24 mm in diameter (Figure 1). The outer lens diameter of the Nikon camera is 22 mm. The bottle top is adapted by cutting a hole in its base, as follows. A Stanley knife (Stanley Company, New Britain, CT, USA) with a retractable blade is used, with the blade projecting only 1 cm. The top is placed on a hard surface and a series of perforations made inside the inner ring, which is visible from the other side (Figure 2). These perforations are then deepened to cut through the plastic. (When force is applied by the knife-wielding hand, the other hand should be moved away to eliminate any risk of injury.) The base is then popped out. If the camera lens diameter is 25 mm or greater, the same method can be used, but with the perforations made on the outside of the inner ring of the bottle top; this would take a little more expertise.

The cut edges are pared down carefully and slowly to create a smooth opening (Figure 3) which will fit snugly over the camera lens but allow rotation of the bottle top on the lens.

As pressure is required to fit the bottle top (which has now become a connector) onto the endoscope, this should be done before attaching the camera. It should be noted that the camera lens does not support the weight of the endoscope or light cable but the customised bottle top simply creates a steady union between the two, in order to enable photography (Figure 4).

Photographic technique

In order to obtain good quality digital endoscopic photography, the digital camera settings must be altered. To compensate for the type of light source used, which is usually halogen or xenon, it is necessary to use the white balance function once the endoscope is attached (with the tip of the endoscope 1 cm away from nonreflective white paper). Using continuous mode inactivates the flash and allows the operator to keep their finger on the shutter button and take multiple photographs. Moving the endoscope in and out slightly while taking photographs allows the camera to change focus and alters the lighting conditions. With a high speed SD (Secure Digital) card fitted, the endoscopist can take up to 20 photographs of each case and select the best images later on. Suboptimal

From the Department of Otolaryngology Head and Neck Surgery, Monklands Hospital, Airdrie, Scotland, UK.
Presented at the Scottish Otolaryngological Society Meeting, May 2007, Dunkeld, Scotland, UK.
Accepted for publication: 24 July 2008. First published online 17 October 2008.

FIG. 1
Evian plastic mineral water bottle top, showing inner ring.

FIG. 2
Making the perforations.

FIG. 3
Paring the opening.

FIG. 4
Endoscope mounted on camera with adaptor.

exposure can be altered subsequently using computer software. However, poor focus cannot be remedied, and it should therefore be ensured, before completing photography, that the images taken appear to be in focus. In the ear canal, an exposure setting of −0.7 appears to reduce the chance of overexposed photographs. The camera requirements are summarised in Table I. The camera used takes common AA size batteries; therefore, low cost, high capacity (>2000 mamph), rechargeable batteries are used and a spare set carried.

Endoscope fitting

Commonly used rigid endoscopes have an eyepiece with a diameter of approximately 30 mm. The diameter of an Evian mineral water bottle top is similar, and the plastic is sufficiently malleable to allow it to fit over the endoscope eye piece, unlike other, similarly sized plastic bottle tops. The fitting accuracy of 28 Evian mineral bottle tops was compared for various, commonly used endoscopes, in the order shown in Table II, in order to eliminate the effect of wear affecting the results.

When initially fitted, the bottle top will appear not to fit; however, once the correct alignment is achieved it will simply pop on.

TABLE I
DIGITAL CAMERA REQUIREMENTS

Lens diameter ≤23 mm, or ≥25 mm up to 29 mm
Zoom lens
White balance function
Close-up function
Continuous mode
Rechargeable batteries
Variable exposure setting

TABLE II
ADEQUACY OF FIT, FOR VARIOUS ENDOSCOPES

Endoscope	diameter (mm)	Adequate adaptor fit*		95%CI
		n	%	
Wolf 0°	4	26	93	77–91
Storz 30°	2.7	24	86	67–96
Olympus 30°	2.7	21	75	55–89
Olympus 0°	4	17	61	41–79
Wolf 0°	4	27	96	82–100

*Of total of 28 tops. CI = confidence intervals

https://doi.org/10.1017/S0022215108003812 Published online by Cambridge University Press

FIG. 5
Clinical photograph of left ear taken with the described equipment, showing retracted pars tensa, middle-ear effusion and attic defect. (Colour online)

Results

Wolf endoscopes gave the best fit, with over 90 per cent of tops fitting exactly (Table II). The more rounded Storz eyepiece also, surprisingly, had a high rate of acceptable fit. Olympus endoscopes had the poorest fit. Therefore, if such endoscopes are used, it is particularly important to ensure a good fit with the bottle top before proceeding with alterations to prevent wasted effort.

Figure 5 shows a typical ear photograph taken with the above apparatus. Figure 6 shows comparative photographs for two different patients undergoing cholesteatoma surgery; Figure 6(a) was taken using the above system, while Figure 6(b) was taken with a commercial in-theatre 'stack' system costing several thousands of pounds. The figures have been annotated to aid orientation. Although their quality is similar, the image produced using the budget-priced system appears slightly better when the photographs are enlarged.

Discussion

Photographic recording is important when documenting disease, demonstrating surgical results, teaching and publishing research findings. Using the above method, any practitioner with access to a zero degree 4mm rigid nasal endoscope can take high quality photographs without having to invest in expensive equipment. This method could therefore make photographic recording affordable in developing countries. A further benefit is the system's easy portability, enabling its use in outlying clinics where endoscopic photography would otherwise not be possible.

The viewfinder screen image of the digital camera used above was not sufficient for diagnosis, but does allow guidance of the endoscope to the area of interest. The method described has resulted in no injuries and appears to be safe. Furthermore, this method can be used in other areas, such as the nasal cavity, or during direct laryngoscopy.

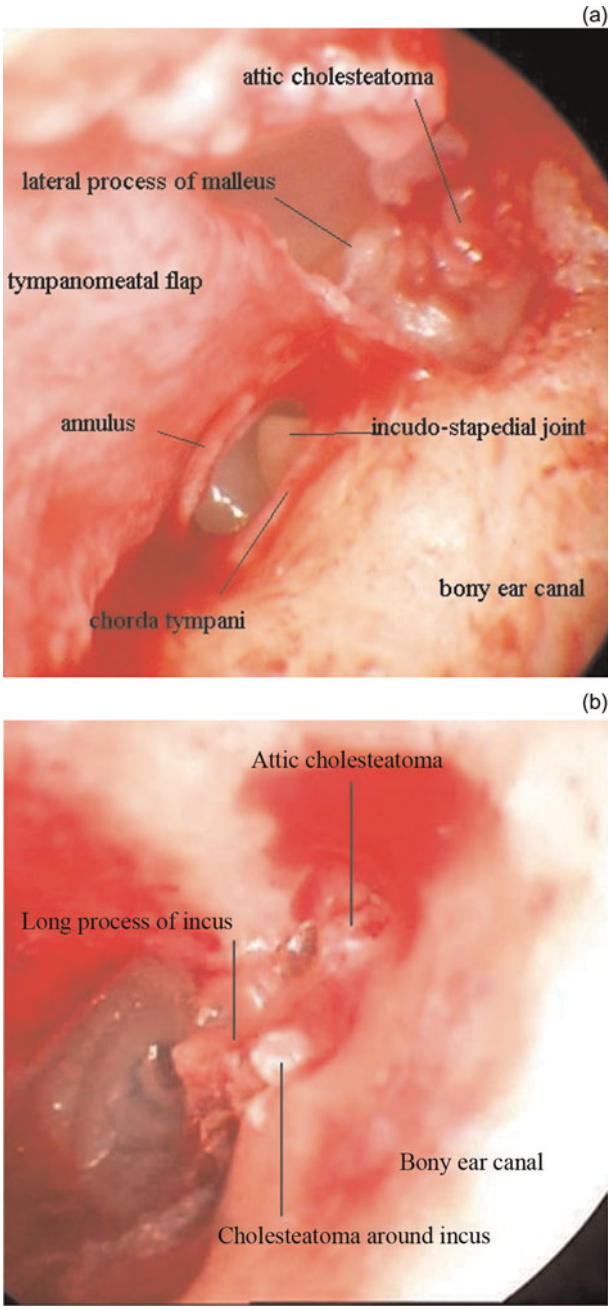

FIG. 6
(a) Intra-operative photograph taken with the system described. (b) Intra-operative photograph taken with a commercial theatre 'stack' system. (Colour online)

For intra-operative use, the camera can be covered in a sterile polyethylene plastic drape or bag. In this situation, the camera shut-down time should be altered to the maximum; for the Nikon Coolpix 4600 this is 30 minutes. If at least one photograph is taken during this time, camera shut down will be prevented. If the camera shuts down, it can be difficult to reunite the camera and endoscope inside the sterile cover.

At present, the Nikon 4600 digital camera is not generally available, although refurbished models can still be obtained for less than UK£100. However, any camera with a zoom lens up to 28 mm in diameter which meets the requirements set out in Table II should be compatible. The described method has been used successfully with a

https://doi.org/10.1017/S0022215108003812 Published online by Cambridge University Press

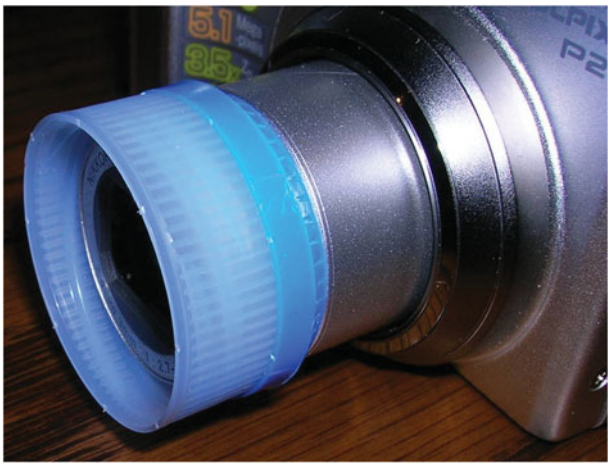

FIG. 7
Volvic plastic mineral water bottle collar, inserted between Evian bottle top adaptor and digital camera. (Colour online)

Nikon Coolpix P2 digital camera. It should be noted that cameras with a lens diameter equal to the diameter of the inner ring of the bottle top cannot be used.

For cameras with longer lenses, the collar from a Volvic plastic mineral water bottle (Volvic, Group Danone , Paris, France) (i.e. the part that separates from the bottle top when the bottle is first opened) can be added between the bottle top and camera, giving better stability in this situation (Figure 7).

Video images can also be taken; however, the video images generated by the Nikon 4600 digital camera are of a poorer quality than those from a camcorder, although this will undoubtedly improve in the future. Video recording is more suited to flexible endoscopy;[4] the described adaptor can be made to fit a nasopharyngoscope eyepiece but may require some paring down of the thread inside the bottle top.

It is more difficult to operate a flexible endoscope connected in the described fashion, due to the distance between the camera and the tip direction lever. This situation can be improved with the use of a suitably strong wire placed around the lever and extended backwards in the form of a trigger. This allows the camera and the body of the endoscope to be held with one hand, while a finger of the same hand operates the trigger to manipulate the tip of the endoscope.

Conclusion

High quality digital endoscopic photographs can be taken with a low cost compact digital camera, using a simple adaptor made from one type of plastic mineral water bottle top.

Disclaimer

If the above method is followed, there should be no risk of injury. However, the author and publisher cannot accept liability for any injury or damage incurred whilst using the procedure described.

References

1 D'AGostino MA, Jinng JJ, Hanson DG. Endoscopic photography: solving the difficulties of practical application. *Laryngoscope* 1994;**104**:1045–7
2 Tabaee A, Johnson PE, Anand VK. Office based digital video endoscopy in otolaryngology. *Laryngoscope* 2006; **116**:1523–5
3 Melder PC. Simplifying video endoscopy: inexpensive analog and digital video endoscopy in otolaryngology. *Otolaryngol Head Neck Surg* 2005;**132**:804–5
4 Tsunoda K, Tsunoda A, Ozawa H, Fujimine T. High-quality video recording and monitoring system for endoscopes. *Laryngoscope* 2005;**115**:1520–1

Address for correspondence:
Mr G D Barr,
Department of Otolaryngology Head and Neck Surgery,
Monklands Hospital,
Airdrie ML6 0JS, UK.

E-mail: gbarr@nhs.net

Mr G D Barr takes responsibility for the integrity of the content of the paper.
Competing interests: None declared