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My Way

Use of a Long Arm Gooseneck Smartphone Holder Optimizes Intraoperative Photography

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The idiom "a picture is worth a thousand words" bears a significant value to our education and better perception of intriguing scientific fact. The use of pictorial representation to express thoughts and ideas has been wildly ventured in the arts and sciences since the olden times. Visual memory remains a useful modality in providing a better understanding of fundamental facts and acquiring valuable knowledge, particularly in medicine. These aids elucidate better results compared with their nonvisual or text-only counterparts. The emergence of digital learning in the present era has followed the natural course of the evolution of learning methods. Photography serves the purpose of valuable knowledge dissemination. Modern-day photography is a result of the advancement of such method of representation, whereby handmade pictures unfolded into film photography followed by digital photography.[1] The most advanced form of representation in this array of technology is the high-definition video photography and the real-time audio-video streaming technology.

MEDICAL OR CLINICAL PHOTOGRAPHY

Medical photography holds immense promise in the evidence-based representation of the medical scenarios and operating room (OR) procedures.[1,2] The paradigm shift in today's academic system is leaning heavily toward the digital learning with emphasis on the clinical photography techniques as an adjunct to aid visual learning. Moreover, live presentation of intricate medical procedures extensively aids in the learning processes of trainees as well as furthering ongoing research of the specialty.[2]

Digital photographic procedures have proven their significance in assessing wound healing,[3,4] dermatological conditions,[5,6] and assessment of patient's specific conditions within a particular time frame. The procedures of clinical or medical photography have not been standardized yet. The highest priorities for digital photography include sharp image quality, specific focus of photograph, stability or anti-vibration of the camera, adequate lighting, and background settings of the photograph. These criteria must be available for a successful digital photograph or video recording of a clinical condition or a surgical procedure.

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Multiple suggestions and guidelines have been implemented in different countries with regards to standardizing medical photography. Distinguishing clinical photography from the general purpose photography is mandatory as the former is patient sensitive with a myriad of educational and ethical ramifications. Informed consent from all patients and subjects prior to photography aids in maintaining the patient's confidentiality by following the mandated ethical protocols.[7]

Application of Smartphones in Medical Photography and Video Recording

Strides within the smartphone industry technology have enabled novel possibilities in the realm of clinical photography. Medical photographs are significantly different from casual snapshots or artistic portraits. At present, medical photographs are taken under standardized views following firmly controlled conditions to accurately display the actual state of the patient at any time-stamped moment.[1,2] The ability to create quality images or videos have tremendous significance to today's medical or surgical context. Thus, optimum-quality medical photographs require meticulous attention to photographic equipment and the use of studio techniques. However, this may not always be feasible in a practical scenario of the hospital or operation theatre setup. Often, a quick photograph taken by a smartphone, without bulky professional gadgetry and instruments, turns out to be far superior then no photograph at all, demonstrating the veracity of the maxim, "the best camera is the one that's on you."[8]

Advances in smartphone-based photography are offering readily available, out-of-the-box opportunities for supreme photographs and videos with minimal configuration in less time than conventional film photography. This technology is becoming omnipresent gaining attention globally owing to its cost-effectiveness, quick and direct implementation, and significant enhancement of the medical learning.

Numerous renowned organizations have proposed standard guidelines about the use of smartphones in the context of medical photography. Such organizations include the Institute of Medical Illustrators (IMI), the General Medical Council (GMC), the Department of Health (DoH), the Joint Information Systems Committee (JISC), and the clinician's local National Health Service (NHS) Trust.[9] Lately, a common and secure digital platform for smartphone-derived medical photography for plastic surgery is developed recently that represents the popularity and effective use of this technology.[10]

SMARTPHONE-ASSOCIATED TECHNOLOGIES

The overly dynamic and fierce market competition of the smartphone industry has galvanized the evolution of both the camera and lens technology of smartphones. This, in turn, has positively influenced the implementation and adoption of smartphones in medical photography.

The demand for medical applications, or "apps," downloaded by smartphone users has led to the development of practical and educational apps for clinicians and patients.[11]

Also, the social media marketing via smartphone apps has the potential to change the future surgeon-patient interactions by offering more custom-made and user-friendly encounters. The role of smartphone apps is vital to the future of plastic surgery as long as plastic surgeons keep an active role in the development of these apps to ensure their value.[12]

Novel film and professional movie cameras have evolved with digital high-end cinematography with relatively larger sensors, selectable frame rates, low or no compression recording options. These high-definition videos are shot seamlessly during movement but are stably maintained.

Following the discovery of such advanced photography techniques, several smartphone manufacturers have extended the adaptations of these supportive techniques on their smartphones to allow for video stabilization or vibration reduction during photography or videography. Similarly, multiple instruments have been developed in recent times to support and prop the smartphones to allow stabilization during HD quality picture or videos.

The gooseneck smartphone clip holder is a flexible, simple, and effective device that is effective in holding a phone at any angle. It permits the phone to be firmly held during photography or video recording, thus, provides the best plausible angle to focus. Figure 1 depicts the specific use of smartphone in an operation theatre and the associated devices to hold the phone and streaming the live or recorded video. The most apparent benefit of a smartphone clip holder is its application as a monopod during intraoperative video recording or photographing. It enhances stability of recording or photograph and minimizes blurry photos. We have embraced this technology for our case and the detail is explained in the following section.

DEVICES USED AND PROCEDURES FOLLOWED

Long Arm Gooseneck Smartphone Holder

The gooseneck smartphone clip holder is a generic descriptor for any smartphone clip holder with a long, sturdy "gooseneck" metallic arm. This can be used universally across devices. It is connected to the phone using a clip device. The other end is attached to the table using a buckle or clamp. The product is employed to secure smartphone or tablets during heavy use, freeing both hands and minimizing hand and arm fatigue.

There are numerous designs of smartphone holders circulating widely on the market within the price range of

Figure 1. Smartphone clip holder mounted on stainless steel stand.

$15-$20; these clip holders designed to hold or fit to all smartphones and almost all tablets (Figure 2).

Choosing a good quality clip holder is of paramount importance owing to its stability producing, highly steady videography and photography, both paramount to efficient medical documentation.

Numerous suitable smartphones are available on the market. At a minimum, a smartphone with 8 or more megapixel camera and plausible compatibility with medical image-related apps should be chosen.

In this study, we employed an iPhone X (Apple, Cupertino, CA, USA) which has a pretty wide aperture ratio ($f/1.8$) that allows for better shots of 90° top-down or flat lays film and photography and capable of recording HD or 4K videos.

Technique

We placed the smartphone in its position at the clip side, where the rear (main) camera of the smartphone was facing the operation field. The clip holder was mounted and secured by its clamp to the OR light or to the stainless steel stand. At this time, you can position or bend the long arm of the smartphone clip holder and adjust the camera setting to get the best view and quality of a recorded video or image (Figure 1).

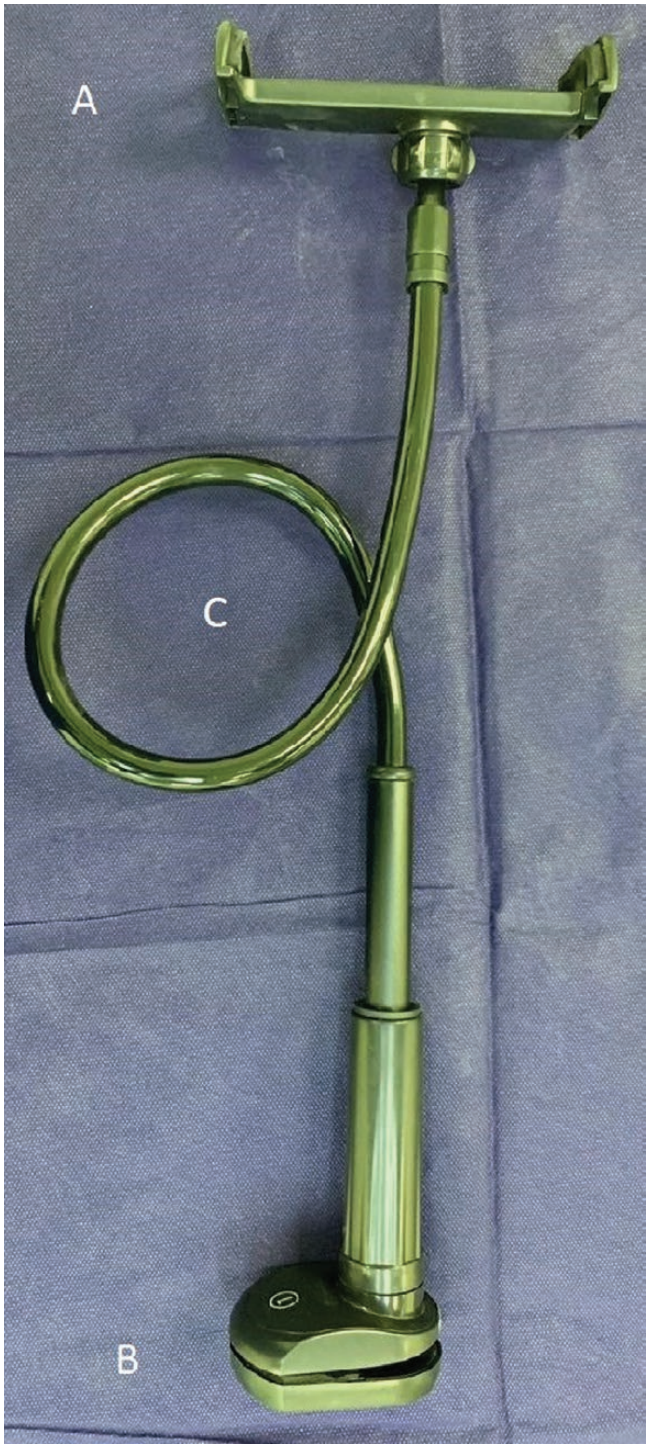
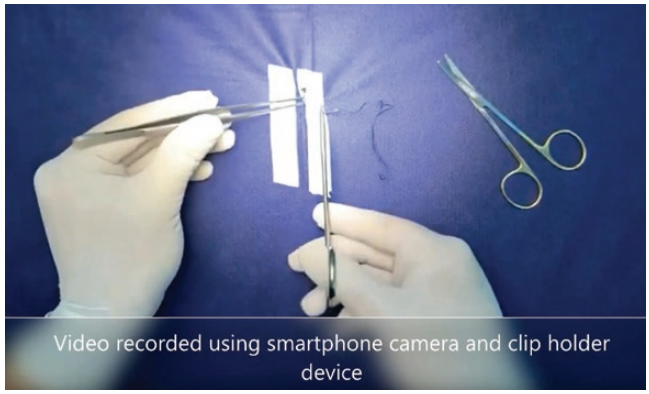


Figure 2. Smartphone clip holder. (A) Clip, (B) clamp, and (C) long flexible arm.

Recording should be sought before the inception of the case to ensure the angle and settings are optimized. Mirroring software on certain phones can be used to allow



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the phone to mirror to a wireless device connected to the OR monitor such as Apple Airplay or Google Chrome cast. This can help the surgeons to see in real time what is being captured by the camera lens.

The phone is set to airplane mode to avoid phone calls or interruptions, another option would be to forward phone calls to another phone in the OR or to the OR phone, if deemed necessary.

The surgeon was able to handle the gooseneck arm either directly with his gloved hand if the accessory is sterilizable or otherwise maneuver it after it is draped with a disposable sterile cover. If a disposable cover is to be employed, it can be slid on to encompass the entire set up including the phone where the lens will be covered by the eye piece cover much like the covers used for microscopes in microsurgery. This will allow the surgeon to handle the phone and move the arm without being restricted to touching the arm alone.

We have begun using this technique many months ago; its application can be employed in multiple surgeries; however, this is dependent on the phone's focal length and width angle. This explains why we found this technique better for hand surgery, periorbital, nasal, and perioral surgery where the field is narrowed to the area being addressed.

Because of the application of the camera to narrow or medium field surgeries, the quality of the high-definition photography and videography is enough with little to no changes in the setting of the smartphone. The camera's settings can be adjusted prior to beginning the case, during patient's induction or preparation for instance, and then the case is begun. If adjustments need to be made intraoperatively, then the draped or sterilized gooseneck arm may be moved and handled by the operating surgeon accordingly. If the camera settings need to be changed, voice control versus an assistant who is not scrubbed can recruited to help, although this is not overly common or necessary.

A sample of a photograph (Supplementary Figure 1) and a video (available online as Supplementary Material at www.asjopenforum.com) using the above-mentioned technique are provided, showing a simple interrupted suturing procedure. The obtained image quality and the stability of the recorded video attest to the success of the methodology adopted.

ADVANTAGES OF USING THE CLIP HOLDER

The idea behind using the gooseneck smartphone clipholder is to optimize the intraoperative photography and video recording, using smartphone held on cheap, wildly available and easily applicable accessories.

Many authors have reported successful results using "selfie-sticks" as a monopod to hold the smartphone during video recording intraoperatively.[13] The clip holder implementation has shown to be superior to the selfie stick in both video recording and digital photography. Our analysis suggests that the clip holder arm is 29″ inches in length and highly flexible, thus, allowing the operator more freedom to twist and reshape the holder at will. The device-holding lazy bracket rotates in a circle, thereby demonstrating that the smartphone clip holder has a greater degree of flexibility and wide arch of rotation, making it an ideal monopod for video recording. Comparatively, a selfie stick has less flexibility and a miniature rotation arch. The smartphone clip holder arm is metallic and can be sterilized or draped (much akin to the robot arm or scope covers). In addition, when using a selfie stick as monopod, the surgeon's hand is occupied holding it, this increases operative time, adds lack of stability due to "shake-effect" and a higher likelihood of breaching sterile technique. The resultant photography or videography may be blurry. If another person is recruited to handle the selfie stick, he/she may increase the risk of infection and affect the traffic flow in the OR.[14,15]

LIMITATIONS

The longevity of the gooseneck clipholder is decreased with each use and sterilization. As it loosens, it may compromise quality of the medical documentation. Parts of the clipholder may not be safe for sterilization and may only be covered with drapes or single-use disposable covers. These protectors are not without their environmental implication.

Operating in numerous anatomical regions (head and neck as well as lower extremity such as in mandibular reconstruction with a fibula osteocutaneous flap) would warrant multiple gooseneck holders which may interfere with one another, especially if they are long armed and within reach of one another. There may be a shortage of stands to mount the clip holders; which may crowd the OR if newer stands are recruited and encumber the workflow.

The positioning of the clipholder may interfere with the OR light source. The position of both should be adjusted, or a head lamp employed. The clip holder may loosen intraoperatively and fall to the ground or onto the OR table or onto the patient; it is imperative to ensure that the clipholder is firmly secured much like we do when securing a hand table or arm board.

Newer OR lights are made of LEDs which subject smartphone photography to the phenomenon of banding or flickering. This happens when the pulses of lights from the OR overhead lights do not align with the frame rate of the smartphone camera. Changing the overhead light is a big endeavor; however, a quick tutorial on how to slow the shutter speed of the camera helps completely removes the strobe effect. Certain phone applications can also help minimize this by calculating the optimal camera settings in relation to the light source's pulse frequency.

Smartphones, like tablets or laptops, have the potential to become a vulnerability that may allow risks to enter the healthcare networks by compromising protected health information. They have an added risk owing to the ease of their misplacement, theft, lack of password protection, neglect of encryption software. To remain HIPAA compliant, application of a framework similar to those in effect for computer networks must be instituted. The National Institute of Standards and Technology (NIST) and the National Cybersecurity Center of Excellence (NCCoE) have issued guidelines for implementing mobile security measures. These include enabling and enforcing passcode protection on the smartphone, use of secure applications that store information safely, avoiding unsecured WiFi networks, providing extensive policies, procedures and training programs, and finally allowing trusted auditing firms to conduct assessment of potential risks and vulnerabilities to the confidentiality, integrity, and availability of patient-sensitive information which may be collected, stored, or transmitted.

CONCLUSIONS

Continuous evolution in the digital technology is changing our world as well as our perception and discovery of facts and scientific events. Smartphones have revolutionized education and have become invaluable instruments of medical photography in the present era. Sharp, high-quality focused HD video recording with minimal setup and expenditure has become reality. Additional inventions of modern and supportive applications and associated firmware are also rapidly expanding the application and usage of increasing our capability of critical recording in conventional ORs. Simultaneously, the development of useful but straightforward accessories such as smartphone clip holders are providing immense support to attain this goal of augmenting quality photographs and videos which can serve limitless benefits in the future. Our approach shows that a simple additional accessory can be highly effective in optimizing the medical documentation without the attendant cost of expensive conventional equipment.
This article contains supplementary material located online at www.asjopenforum.com.

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