

Review Article

Smart apps for the smart plastic surgeon

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ABSTRACT

Smartphones have the ability to benefit plastic surgeons in all aspects of patient care and education. With the sheer number of applications available and more being created everyday, it is easy to miss out on apps which could be of great relevance. Moreover, the range of android applications available has not been extensively discussed in the literature. To this end, we have compiled an exhaustive list of android smartphone applications, which we feel can help our day to day functioning. The apps have been extensively reviewed and neatly described along with all their potential uses. In addition, we have made an effort to highlight 'non-medical' or efficiency apps which can improve departmental functioning. These apps have not been described in prior articles, and their functionality might not be known to all. We believe that the technology savvy plastic surgeon can make maximum use of these apps to his benefit.

KEY WORDS

Android; apps; education; mobile phones; smartphones

INTRODUCTION

Smartphones are becoming omnipresent in every aspect of our daily lives. It was the English author Arthur Clarke who postulated his law 'Any sufficiently advanced technology is indistinguishable from magic'. Nowhere is this statement truer than in the field of medicine. We can only imagine what further miracles the likes of Sushruta, Harold Gillies or Ralph Millard might have performed if they had access to today's technology. With the potential for developing apps to suit any need it is natural that they find increasing use in the medical field. The increasing


number of articles in recent times on this subject proves their growing usefulness.^[1]

The utility of smartphones in plastic surgery is varied:

- To improve communication between members of a plastic surgery team.
- To enable ease of data collection and storage.
- To enable easy and detailed reference on any topic.^[2]
- For students/educational purposes.
- To improve patient understanding and communication.
- For postoperative monitoring.^[3]

The most popular smartphone operating systems (OS) in use today are the iOS by Apple and the android OS by Google. Prior articles have detailed iOS apps for plastic surgeons,^[4,5] but very few have discussed android apps.^[6] And for this reason we will be focussing on android applications in our review.

There have been numerous articles highlighting the various apps available for reference and educational

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purposes for the plastic surgeon. However, there are very few articles which seek to educate doctors on the way in which 'non-medical' apps can be used to improve efficiency and communication within a department. This is an area in which our department has innovated extensively, seeking to use smartphones for maximum efficiency and benefit. Hence, our review aims to focus on the 'non-medical' apps which are potentially (equally if not more) useful for the day to day functioning of the plastic surgeon. At the same time, we will also cover the most relevant medical reference apps available in order to give a comprehensive review as well as highlight some of their uses which might not have been realised previously. We have mentioned all the alternative apps available for each function and highlighted the ones which we feel function best.

FUNCTIONALITY/EFFICACY APPS

Google Drive (Google Inc.).

(Free on Google Play. Needs data connection for use).

Alternatives — Dropbox, OneDrive, CM Backup.

This is probably the single most useful app for the medical professional that we have found. It has transformed the day to day functioning of our department. Developed by Google, this is basically a cloud storage app. The concept of cloud storage is that information of any kind can be stored on a 'cloud' which is a remote server instead of your phone. This cloud can then be accessed from any location. The advantages of this are readily apparent:

- Increased storage space.
- Better security.
- Ability to access all your information from any location without the need to carry storage devices.^[7]
- Ability to access the same file from multiple devices. Furthermore, a file that has been edited on one device gets updated across all devices.
- Ability to share large files amongst members of a department.

The Google Drive app offers free cloud storage up to 15 GB of data. There are other cloud storage applications like Dropbox, but Google Drive is more convenient due to the universality of a Gmail ID, and the ability to integrate Google Drive with other Google applications such as Google Docs and Gmail.

To use Google Drive, we have created a common user ID for our department on Gmail and opened a Google Drive with that account. We then shared this account with all members of our plastic surgery team such that any file uploaded on this Google Drive can be viewed and edited by any member of the team (using their own unique id and password). This sharing can only be done by the owner of the Google Drive (in this case the department ID). In this manner, there is a firm control over who can see and edit potentially sensitive medical information. Any editing of documents is extremely simple either by phone or computer as Google Drive has Google Docs integrated which enables us to use Microsoft Office documents such as Word, Excel, PowerPoint, and also PDF files with ease. The presence of picture archiving and communicating system in our hospital further increased the efficacy of Google Drive, as changes to the drive could be made from any computer in any ward. Once this shared Google Drive was established, we then discovered the following myriad of uses for it over the course of several weeks.

1. Patient lists — In a high volume centre, there are multiple admissions round the clock. And it is necessary to ensure that all members of the team are kept up to date of any new admissions or discharges. This level of communication can be quite a challenging task with potential for mishaps. On Google Drive, we have maintained a 'current patient' list in real time which shows the total number and distribution of patients at any given time. Any new admission or discharge is updated by the resident on call, and this is then immediately available for all members of the team to see. This list can be as detailed or as concise as one would prefer though we usually use the patients' name, IP number, age, sex, diagnosis and ward.
2. Discharge summaries — This is probably the most useful way that Google Drive has changed our department functioning. Previously, we had a system of residents writing/typing a temporary discharge summary, which was approved by a consultant, and then finally being typed and printed, with all of this being done on one department computer. This was obviously a waste of both time and effort. With Google Drive, a resident can type a discharge summary on any computer in any ward. This can then be seen by a consultant on his smartphone immediately. The corrected version can then be printed from any computer with access to a printer. And at the same time, a record of the summary is created on the Google Drive. This is an example of how Google Drive integrates use of both desktop computers as well as smartphones.

3. Photo albums — Plastic surgery is a photography oriented field, with periodic photographs of a patient's progress critical both for surgeons planning and for patient counselling. It often happens, particularly for patients with prolonged hospital stays that photos of the patient are taken by a different member of the team at different times. Organizing and sharing of these photos can be a cumbersome and time-consuming process. A photo album was created for each patient on our Google Drive. This enabled any member of the team to upload photographs to a particular patient's folder, thus ensuring collection of all photos as well as organisation in an easy manner. It was ensured that specific photography consents were taken for all patients, and the patients' confidentiality was given utmost importance.
4. Seminars — Residents starting using Google Drive to upload their seminars or journal articles for journal clubs, which could then be accessed by all members. This enabled access to seminar material on smartphones and eliminated the need for paper printouts.
5. Other files that we started sharing on the Google Drive include the following:
 - a. Operative lists — Just as with patient lists, we soon started putting our OT lists on Google Drive, so that everyone could have access to the next day's list and prepare accordingly.
 - b. Academic schedules.
 - c. Duty rosters.

To summarize, the above uses of Google Drive improved departmental communication and functioning, and at the same time reduced the usage of paper.

WhatsApp Messenger (WhatsApp Inc.).

(Free on Google Play. Needs data connection for use).

Alternatives — Hike Messenger, Viber, WeChat, Google Hangouts, Yahoo Messenger, Facebook Messenger.

WhatsApp is a cross-platform messaging service that enables users to easily send messages and photos to multiple people at once. We have created a WhatsApp group with all members of the department. This enables easy and immediate communication amongst members and avoids any lapses in the chain of information. Another advantage is the ability to send photographs and operative videos. This enables easy evaluation of

cases by multiple consultants and is particularly useful in postoperative monitoring of cases, especially free flaps. An on-call resident can send photos of any case to a senior for a second opinion, enabling rapid sharing of information and decision-making. The efficacy of this communication has already been evaluated in some studies.^[8]

Evernote (Evernote Corporation).

(Free on Google Play. Can be used offline).

Alternatives — Google Keep, OneNote, Notepad.

While there are many note-taking apps in the android market, we found Evernote to be the most functional and easy to use. With this app, notes on any subject can be quickly taken down, edited, highlighted, organised into checklists and tasks. Evernote also adds the ability to integrate audio recordings and photos into the note itself, making it a boon for residents during classes. The notes can also easily be shared via multiple avenues.

Wunderlist: To-do List and Tasks (6 Wunderkinder GmbH).

(Free on Google Play. Can be used offline).

Alternatives — Any do, GTasks, Todoist.

Wunderlist is a list making app aimed at usage by teams rather than individuals. A to-do checklist can be maintained and updated by any member of a team. This way all residents can be aware of any pending tasks for any patient and simultaneously update the concerned consultant of any tasks completed.

Surgeon's Logbook (Varun Shetty).

(Free on Google Play. Can be used offline).

Alternatives — Apps of the same name by AppsLand, IQject.

This app enables the surgeon/resident to record all his daily activities, with separate tabs for operative logs, bedside procedures, academics and postings. The operative log in particular is highly useful with fields for patient details, operative notes and attachments including photos. The records can also then be exported into Microsoft Excel, making record keeping for studies, academics etc., easy and accurate.

MAKING YOUR OWN APP

It is quite easy to make your own applications for simple purposes using the website appsgeyser.com.^[9] This website enables one to make apps aimed primarily for viewing and reference, without too much processing involved. We have developed the following apps using this website:

1. Case sheet writing app — We have built an app with easy reference for residents to the common plastic surgery cases. The app includes a list of all the history to be elicited, and the points to be covered for examination of each case. This is highly useful for day to day case sheet writing as well as reference for case presentations and exam preparation. This also ensures uniformity of case sheets.
2. Academic schedule — We develop an app every month containing the months academic schedule including resident name, topic and moderator. This enables easy reference and optimises preparation for academics.

EDUCATION/REFERENCE APPS

Medscape (WebMD, LLC).

(Free on Google Play-200 MB download needed for offline use).

Alternatives — Epocrates.

This is easily the most comprehensive reference app available on a smartphone for any medical professional. While it is space occupying at nearly 200 MB it is well worth it. It has an extensive reference section which essentially compiles all information available on most textbooks across all fields. Moreover, it is regularly updated with the latest evidence and recommendations. This is essentially a one stop solution for any queries in medicine one might have.^[10] Of particular interest to the plastic surgeon are the following:

- Procedures — A separate section on reconstructive and aesthetic procedures exists, covering topics from abdominoplasty to lip augmentation. All are divided into easy headings such as workup, preoperative, intraoperative, postoperative, etc. While it may not be as extensive as dedicated textbooks, it is a good reference and starting point to look up any new procedure, for detailed reading later.
- Anatomy — Medscape has an extensive anatomy reference with good diagrams and references.

- Drugs — Any doubts about the dosage or route of a drug can easily be looked up with Medscape. Moreover, it has an interaction checker, to avoid complications with multiple drugs.
- Calculators — Medscape has a calculator for almost any medical formula, so they do not have to be known by heart. Of particular usefulness for us plastic surgeons, is the calculator for the Parkland burns formula. You simply enter the weight and the calculated burns percentage and it calculates the fluid rate in seconds. This saves time and effort and avoids mistakes while handling burn emergencies.

In conclusion, Medscape is a must have app for any medical professional.

UpToDate for Android (Wolters Kluwer Health).

(Free on Google Play for installation. Needs paid subscription and data connection for use).

This is a clinical decision support resource, with the latest guidelines and evidence on all medical topics collected and organised into easy to read articles. As the name suggests, its aim is to have the latest clinical evidence, ahead of what appears in textbooks. This app has been endorsed by several leading medical institutions, and several studies have shown that its use improves patient care.^[10] While the plastic surgery topics are still not every extensive, it is a very useful app for referencing the latest evidence across most fields of medicine.

AO Surgery Reference (AO Foundation).

(Free on Google Play. Needs data connection for use).

This is an official application containing the guidelines for fracture management by the AO foundation. Of particular interest to plastic surgeons is the part on hand trauma, as well as maxillofacial injuries. Each bone or region can be selected individually, followed by the type of fracture. The app then outlines all approaches as well as reductions and fixations available for management, including aftercare [Figure 1].

Touch Surgery (Kinosis).

(Free on Google Play. Needs data connection for downloading surgeries which can then be seen offline).

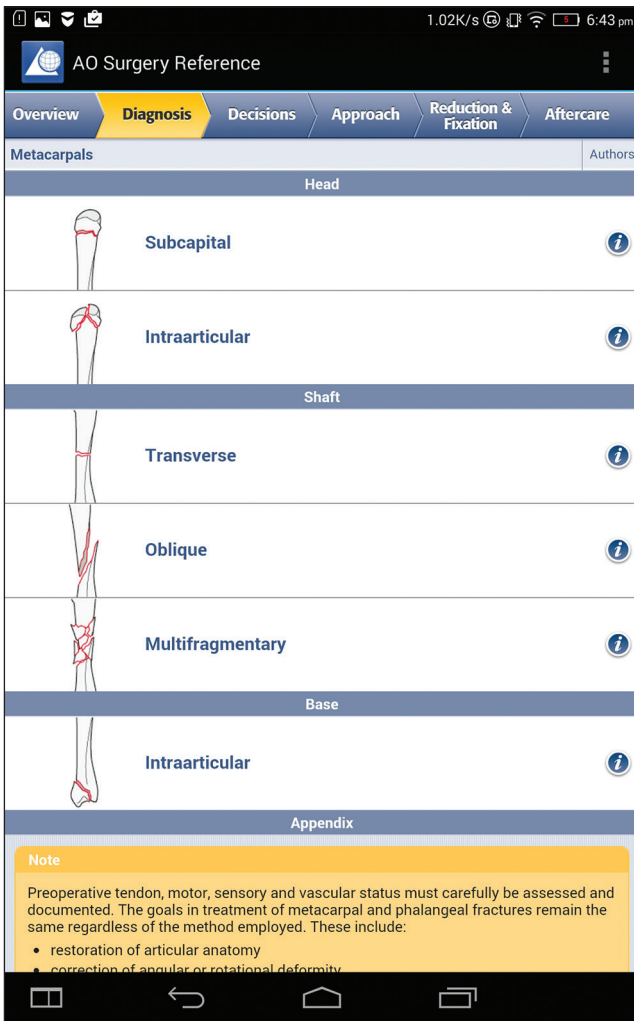


Figure 1: AO surgery reference showing overview of metacarpal fracture

This is a unique surgical simulation and education app that is one of a kind. It breaks various surgeries into fundamental steps and decision points. This enables you to interact and rehearse each surgery in a virtual environment [Figure 2]. Along with learning steps, one can then test himself or herself by virtually performing the surgery. Various surgical specialities are offered including plastic surgery. While the variety of plastic surgery procedures at present is limited, this will be expanded in coming time. This is a very exciting app that could greatly enhance surgical education.^[11]

BurnCare (Pierre-Antoine Meley).

(Free on Google Play. Can be used offline).

This relatively unknown app is one that can be quite useful. It is aimed at early assessment and resuscitation of

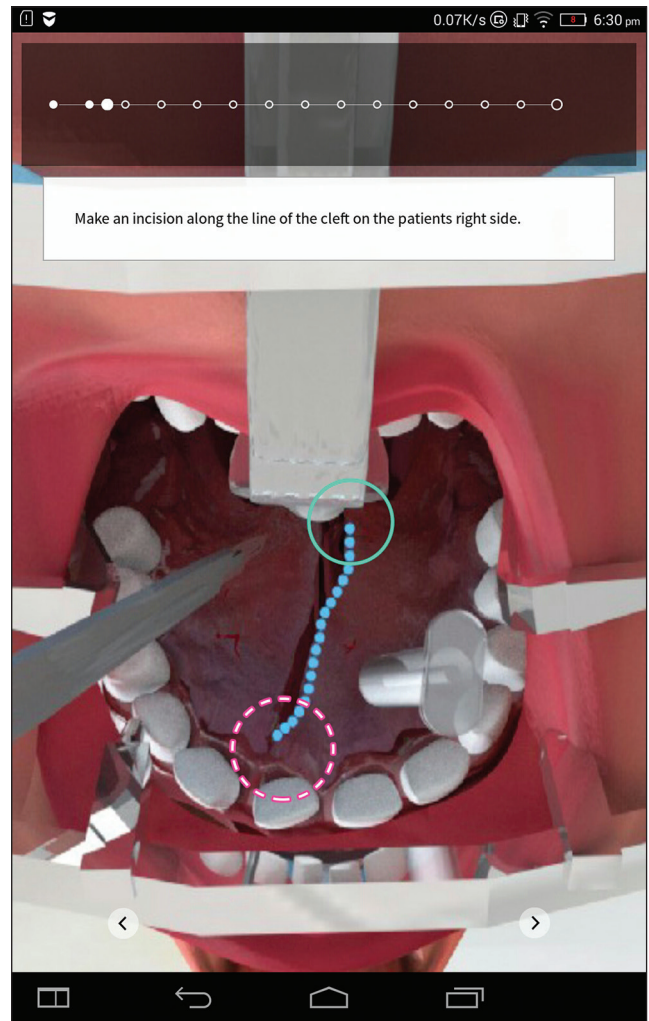


Figure 2: Touch surgery app showing steps of cleft palate surgery

burns patients. It helps to calculate the burns area as well as fluid requirements in the emergency setting. The first screen asks for patient details like age, height, weight and adjusts the Lund and Brower charts accordingly. The next page shows a Lund and Brower chart, on which burns of different degrees can be shaded in. This then calculates the total burn surface area as well as the fluid requirement in the Parkland, Evans and paediatric Carvajal formulas [Figure 3]. This is especially useful and time-saving for emergencies, as the formulas and charts might not always be readily available.

iFlap: Plastic Surgery App (QMP).

(Lite version free on Google Play. Full version is paid. Can be used offline).

This is a very unique app aimed at the reconstructive surgeon to aid in decision-making process as well as a

quick reference to common flaps. Flaps can be looked up by name. Else a particular anatomical location can be selected, and the available flap options are then shown. Upon clicking a flap, the anatomy, markings, dissection are shown with stepwise diagrams, as well as few short videos [Figure 4].

AnatomyLearning — Three-dimensional (3D) Atlas (AnatomyLearning).

(Free on Google Play. Needs data connection for use).

Alternatives — Visual Anatomy, Human Anatomy Atlas, 3D Anatomy.

This is a virtual atlas of human anatomy, which offers an incredible 3D reconstruction of anatomical structures, which can be rotated and viewed about any axis to learn comprehensive relationships between different anatomical structures [Figure 5]. Along with this 3D

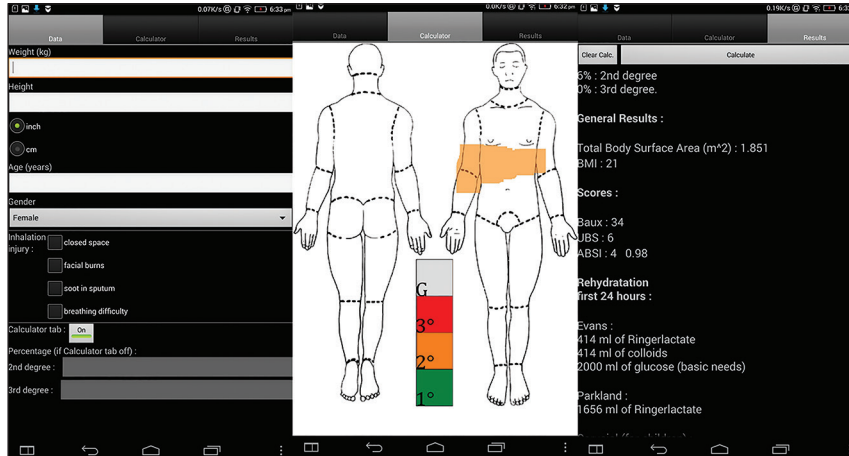


Figure 3: BurnCare app

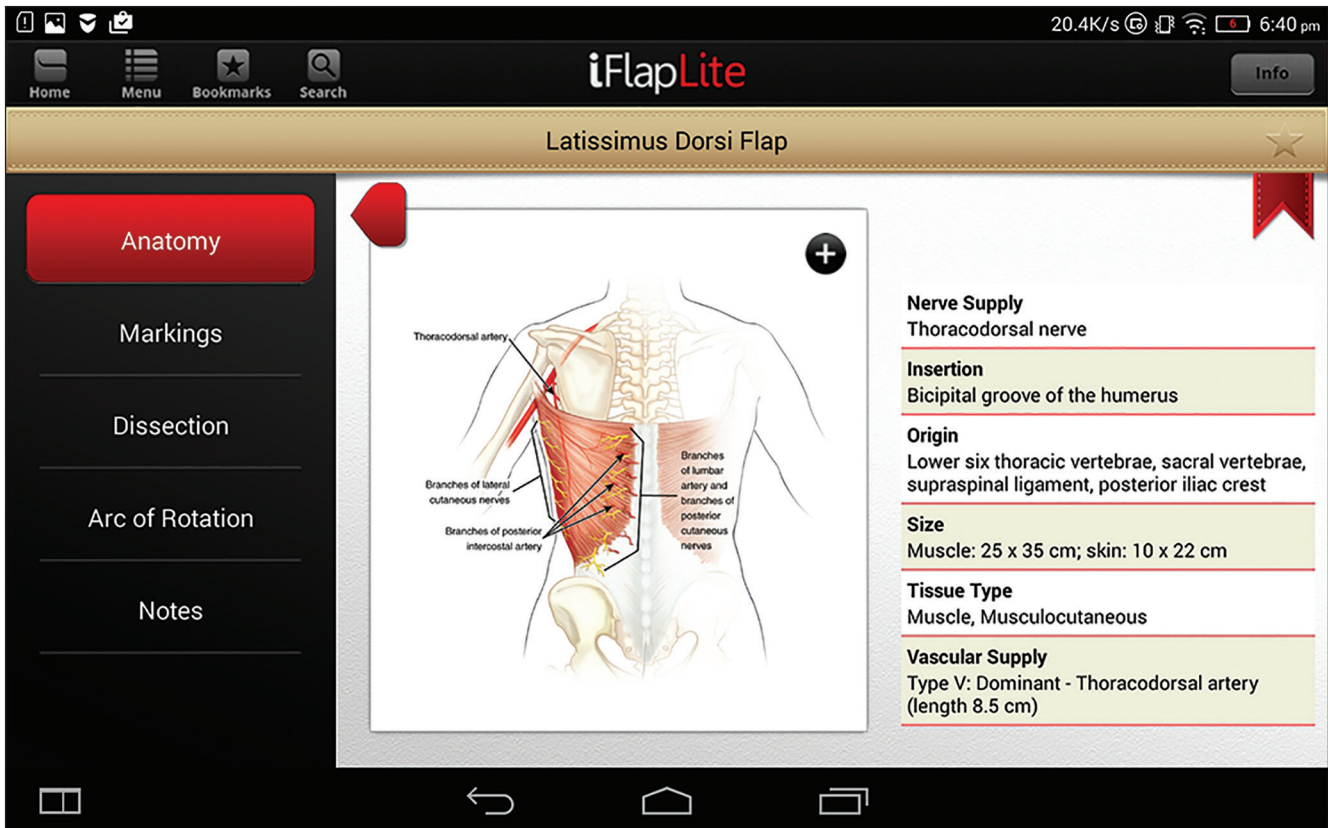


Figure 4: iFlap app showing details of latissimus dorsi flap

viewing, text about origins, insertions, courses etc., can also be accessed.

Plastic surgery simulator (Kaeria).

(Lite version free on Google Play, full version paid. Can be used offline).

Alternatives — Face Warp, Photo Plastic Surgery.

This is a photo distortion app, which might have been created for entertainment purposes but has possible applications for aesthetic surgery. With it, a surgeon can take a patient's photo, and then distort it to demonstrate to the patient, the possible results of procedures like rhinoplasty, augmentations, body contouring. While it may not be completely reliable, it is a useful tool for patient counselling.

Goniometer Records (Indian Orthopaedic Research Group).

(Free on Google Play. Can be used offline).

This app functions to measure angles across all joints of the body. The relevance of this is immediately apparent, particularly for contracture and hand surgery. This app makes use of the internal gyroscope of a phone. A first reading is taken to calibrate 0°, followed by another reading of the angle to be measured [Figure 6]. We have found the values to be quite accurate. Moreover, the values can also be saved for a particular patient record, making serial measurements easy for comparison on follow up.



Figure 5: Anatomy learning app showing details of arterial arches of the hand

PubMed — Unbound MEDLINE (Unbound Medicine, Inc.).

(Free on Google Play. Can be used offline).

Alternatives — PubMed Mobile, PubMed Search.

This is an app that makes searching for any PubMed indexed article easy and quick, with links directly to the publishers, along with easy links to related articles.

JOURNALS

Several journals have developed their own apps, to enable easy search and viewing of articles. Some of these are open access while others offer only abstracts for non-subscribers. These apps are superior to conventional web browsing as they offer options such as bookmarking, article listing, and social networking functions. The journal apps we found to be of interest to the plastic surgeon include the following:

- Plastic Surgery (PS Journal) (ATIV Software) — Journal of the Canadian society of plastic surgeons.
- Wounds (HMP communications) — An open access journal on all aspects of wound care.
- Journal of Hand Surgery (E) (Sage publications, Inc.) — An open access journal on hand surgery (European edition).
- Hand (Springer).
- HandFeed (Hand Fed Apps) — This is a RSS based abstract collection app which gathers articles from multiple journals on hand surgery.

Hopefully in the near future, all journals would be having their own app for ease of use.

Concerns regarding smartphone use.

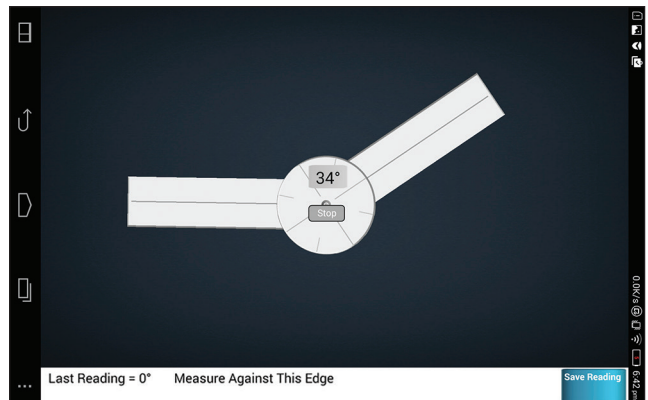


Figure 6: Goniometer app

As with any new advance, certain concerns exist. These have also been highlighted in previous articles on this subject.^[12]

1. Security — Security is a concern, especially for cloud storage applications, made more relevant in the light of recent hacking scandals in the United States. To address this issue, we use Google Drive only for temporary storage of information of active patients. Processed discharge summaries as well as completed photo albums are then downloaded onto our hard disks, thereby minimizing the information kept on the web. At the same time, Google Drive's security certificates are excellent with so far no major reported incidences of hacking.
2. Patient confidentiality — This is another concern raised in the light of sharing information and photos on WhatsApp. To address this concern, we take separate informed photography consent for all our patients. And no information is shared with anyone outside the plastic surgery team. Any sensitive photographs are also shown in person instead of WhatsApp.
3. Reliability — The reliability of internet based resources has always been questioned. However, newer applications such as Medscape and UpToDate have now been found to be reliable for decision-making. While apps offer ease of use at the point of care scenarios, it is prudent to cross check any new app with established sources of information.^[13]

It is the responsibility of the treating surgeon to ensure that any tool is used for furthering progress rather than for detrimental purposes. It is our opinion that the benefits smartphones offer far outweigh any possible risks.

An “eye” to the future.

The advances being made in technology today are nothing short of remarkable. The next big innovation appears to be in the field of wearable technology. The most famous example for this is Google Glass, which is basically a spectacle with a computer and projection screen built in which can superimpose images onto what is being viewed in real life. This has already been experimented in the operating room. Some surgeons are using Google Glass to record their surgeries, and also stream it live to other centres for educational

purposes.^[14] One can imagine the possibilities if the above-mentioned apps are integrated with wearable technologies. It is not too farfetched to imagine a day in the near future, when operating steps are being viewed on the Glass in real time while the surgery is being performed, or the Google Glass itself identifying anatomical landmarks. The first version of Google Glass is in its initial stage of release, with a few handpicked volunteers testing its applications in various fields. More recently, Microsoft announced its similar device called HoloLens, which appears to be even more advanced. While it is still early days for these technologies, the future appears to be nothing short of miraculous.

CONCLUSION

To sum up, smartphones can and will revolutionize the healthcare industry. As Charles Darwin once said, the individuals with the greatest ability to thrive are those that can adapt. The apps we have highlighted in this review serve a wide range of functions which can revolutionize plastic surgery education and practice. Embracing the use of technology in a responsible manner can increase efficiency, better communication, improve education, and ultimately lead to better patient care, which is the ultimate source of happiness for any doctor.

REFERENCES

1. Amin K. Smartphone applications for the plastic surgery trainee. *J Plast Reconstr Aesthet Surg* 2011;64:1255-7.
2. Valcke M, De Wever B. Information and communication technologies in higher education: Evidence-based practices in medical education. *Med Teach* 2006;28:40-8.
3. Engel H, Huang JJ, Tsao CK, Lin CY, Chou PY, Brey EM, *et al.* Remote real-time monitoring of free flaps via smartphone photography and 3G wireless Internet: A prospective study evidencing diagnostic accuracy. *Microsurgery* 2011;31:589-95.
4. Freshwater MF. iPhone and iPad applications for plastic surgeons. *J Plast Reconstr Aesthet Surg* 2011;64:1397-9.
5. Al-Hadithy N, Ghosh S. Smartphones and the plastic surgeon. *J Plast Reconstr Aesthet Surg* 2013;66:e155-61.
6. Amin K, Edmonds K, Abboudi H, Sivakumar B. Smartphone applications for the plastic surgeon: An update of Google's Android operating system. *J Plast Reconstr Aesthet Surg* 2012;65:1440-2.
7. Gan A, Okonkwo O. The use of Google Drive in clinical audit. *Br J Hosp Med (Lond)* 2014;75:397-8, 400-1.
8. Wani SA, Rabah SM, Alfadil S, Dewanjee N, Najmi Y. Efficacy of communication amongst staff members at plastic and reconstructive surgery section using smartphone and mobile WhatsApp. *Indian J Plast Surg* 2013;46:502-5.

9. Available from: <http://www.appsgeyser.com/>. [Last accessed on 2015 Feb 08].
10. Egle JP, Smeenge DM, Kassem KM, Mittal VK. The Internet school of medicine: Use of electronic resources by medical trainees and the reliability of those resources. *J Surg Educ* 2015;72:316-20.
11. Wodajo F. Apps for today's surgeon and the future of mobile devices in the operating room. *J Surg Radiol* 2011;2:225-31.
12. Gardiner S, Hartzell TL. Telemedicine and plastic surgery: A review of its applications, limitations and legal pitfalls. *J Plast Reconstr Aesthet Surg* 2012;65:e47-53.
13. Buijink AW, Visser BJ, Marshall L. Medical apps for smartphones: Lack of evidence undermines quality and safety. *Evid Based Med* 2013;18:90-2.
14. Schreinemacher MH, Graafland M, Schijven MP. Google glass in surgery. *Surg Innov* 2014;21:651-2.

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