

# Teleassistance and teleconsultation using smartphones and its contribution in clinical progress of oral and maxillofacial surgery

## ABSTRACT

Smartphones, an advanced mobile device having combined function of a computer and cellular phone, have become an effective communication within and between specialties for management of patients. It provides voice, text, multimedia messages, camera, and E-mail option and helps the surgical team to communicate with each other. The application of computer technology in the field of cranio and maxillofacial surgery opened a new perspective in the preoperative planning and accurate intraoperative realization of treatment concept. A PubMed, EMBASE, and Web of science search of the English literature were done to review the English literature on teleassistance and teleconsultation using smartphones and its contribution in clinical progress of oral and maxillofacial surgery. Fifteen articles were found the relevant data were extracted and tabulated. Conclusion was drawn that teleconsultation using smartphones is a useful tool for specialized consultation, diagnosis, treatment, and follow-up in remote areas. With technological evolution, new methods of delivering better health-care facilities can be possible with the help of smartphones.

**Keywords:** Smartphone, teleassistance, teleconsultation

## INTRODUCTION

Teleassisted surgery was first developed for neurosurgery which includes stereotactic component, invented in 1906 by Horsley and Clarke. In 1918, a stereotactic instrument was developed by the neurologist Aubrey Mussen to position it relative to the human skull based on an anatomic atlas.<sup>[1]</sup> A medical telecommunication system called Piedmont Aosta Valley Axial Tomography Cranial Trauma (PATATRAC) was created in Piedmont in 1977 to provide neurosurgery consultation in real time. Hence, this system was first used in 2002 by Maxillofacial Surgery Division of San Giovanni Battista Hospital in Turin.<sup>[2]</sup> The application of computer technology in the field of cranio and maxillofacial surgery opened a new perspective in the preoperative planning and accurate intraoperative realization of treatment concept.<sup>[3]</sup>

In recent years, smartphones, an advanced mobile device having combined function of a computer and cellular phone, have become an effective communication within and between

specialties for the management of patients. It provides voice, text, multimedia messages, camera, and E-mail option and helps the surgical team to communicate with each other.<sup>[4]</sup> It runs on an application called apps which differentiate it from Symbian phones. The current popular smartphone operating systems have a respective online store to browse

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**Received:** 17 February 2018, **Revised:** 20 April 2018, **Accepted:** 04 October 2018, **Published:** 18 June 2020

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**How to cite this article:** Singh G, Pal US, Mishra M, Gaur A, Pathak D, Singh YB. Teleassistance and teleconsultation using smartphones and its contribution in clinical progress of oral and maxillofacial surgery. Natl J Maxillofac Surg 2020;11:10-3.

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<b>Website:</b> www.njms.in	<b>Quick Response Code</b> 
<b>DOI:</b> 10.4103/njms.NJMS_9_18	

and download applications. These stores are Google Android, BlackBerry App World, and iPhone app.<sup>[5]</sup>

Sometimes, patients need to be covered from distant hospitals by maxillofacial surgeons; delay in communication can increase the problem associated with their handover and lead to longer stay and poor perioperative care. Due to a combination of functions in smartphones, maxillofacial surgeons can immediately provide with consultation and opinion. Farman and Farag reported that telemedicine should be an alternative to a second opinion in dental practice and that this system could provide economic benefit by allowing patients in remote areas access to specialized medical care without the difficulty and cost of travel to distant medical centers.

## MATERIALS AND METHODS

A PubMed, EMBASE, and Web of Science search of the English literature were done. Keywords for the search was smartphone, teleconsultation, teleassistance. Relevant articles from the list of the retrieved articles were considered. Full text of potentially relevant studies was retrieved and reviewed. The aim of this paper was to review the current english literature on the use of smartphones as a teleassistance and teleconsultation

device for the clinical progress in the field of oral and maxillofacial surgery.

## RESULTS

Fifteen articles were found in the online database. The relevant data were extracted and tabulated. Conclusion was drawn and discussion was done [Table 1].

## DISCUSSION

In 1996 at the university hospital of cranio-maxillofacial and oral surgery, Vienna, the first live transmission of an operation through the internet, was accomplished.<sup>[6]</sup>

In OMFs, intra-, pre-, and postoperative position of bone segments, tumors, and pathologies can be discussed by use of teleconsultation/teleassistance technology with the possibility of on-screen treatment planning interaction and interdisciplinary real-time evaluation of the results.<sup>[1]</sup>

Jacob *et al.* in 2002 studied the diagnosis of maxillofacial fractures using conventional radiology and digital radiology; they reported the usefulness of the electronic system and emphasized that clinical information was of crucial

**Table 1: Conclusion of articles included in this study**

Authors	Year	Comments
Wagner <i>et al.</i>	1999	Teleconsultation with remote experts is a useful tool
Jacobs, Edmondson, Lowry	2002	Telemedicine system was a useful tool to aid diagnosis of most facial fractures
Yaghmai	2004	Wireless PDA may function as a robust medium for facilitating care of brain trauma patient by allowing rapid access to radiologist or neurosurgeons
Roccia, Spada, Milani, Berrone	2005	PATATRAC reduces expensive and unnecessary transfer of maxillofacial patients, without indication for either immediate or deferred treatment, also avoiding discomfort to the patients with other injuries
Ewers <i>et al.</i>	2005	Telecommunication technology can contribute to a quality improvement in cranio and maxillofacial surgery because of the global availability of specialized knowledge
Moumoulidis, Mani, Patel, Leong	2007	Telephone consultation in combination with a digital image would provide a more accurate means of diagnosis of nasal fractures <sup>[6]</sup>
Pereira <i>et al.</i>	2008	Distant diagnosis can be an effective alternative in the diagnosis of oral lesions and that using two distant consultants improves diagnostic accuracy <sup>[7]</sup>
Aziz, Ziccardi	2009	The use of smartphones telemedicine is an efficient and effective way for remote specialist consultation
Kaltman, Best, Kaltman	2012	Smartphones are used for virtual rounding between residents and faculty based on improvement in technology
Pandian, Srinivasan, Mohan	2014	Smartphones can use various application which has revolutionized the use of these devices
Carey, Payne, Ahmed, Goodson	2015	Reviewed a list of useful and relevant apps for the modern maxillofacial surgeon using the iPhone as an example platform
Dhuvad, Dhuvad, Kshirsagar	2015	Utilization of smartphone in oral and maxillofacial surgery facilitates in differential diagnosis, treatment, follow-up, prevention of the disease and improves the quality of patient care
Rokadiya, McCaul, Mitchell, Brennan	2016	Assessed the safety and usefulness of current methods of digital communication
Pulijala, Ma, Ju, Benington, Ayoub	2016	3-D visualization and interactive applications in improving the understanding of the surgical procedures <sup>[14]</sup>
Wood, Strauss, Janus, Carrico	2016	Telemedicine technology is an important step for overcoming current issues with patient access to care <sup>[15]</sup>

PDA: Personal digital assistant

importance. They also reported that sensitivity of diagnosis was 86% with the telemedicine system. Fracture was more accurately diagnosed on orthopantomogram. Mandibular fractures were more accurately diagnosed than zygomaticomaxillary complex fractures.<sup>[2]</sup>

Telemedicine system has two types: live interactive and store and forward. The live interactive systems operate in real time and include a video monitor and high-resolution camera. The store and forward technology can be described as E-mail pictures; the clinical history collected according to a detailed consultation protocol is accompanied by radiologic and photographic images to support the clinical history.<sup>[7]</sup>

The first Italian telemedicine system, called PATATRAC, was created in Piedmont in 1997 for the purpose of providing neurosurgical consultation. From 2002 to 2004, thirty-five regional hospitals on line with PATATRAC have sent 18 consultations to the maxillofacial surgery division of San Giovanni Battista Hospital in Turin, for telemedicine evaluation of the patient with maxillofacial trauma, allowing the creation of clinical protocol for managing maxillofacial trauma.<sup>[7]</sup>

- Immediate transfer to the reference center in the following cases:
  1. Craniomaxillofacial trauma requiring urgent neurosurgical treatment
  2. Polytrauma with orthopedic and/or thorax pulmonary and/or abdominal injuries that cannot be managed from the referring hospital and associated with maxillofacial fractures
  3. Multiple comminuted, exposed fractures of the maxillofacial region
  4. Massive bleeding of the head-and-neck region in hemodynamically stable patients
  5. Complex trauma of the orbital region with suspected compression of the eyeball and/or optic nerve and requiring concomitant ophthalmic consultation.

In all of these cases, transfer to the referral center should occur after the patient's general clinical condition, and vital signs have been stabilized.

- Deferred transfer  
In the absence of urgency reported in point 1, the polytrauma patient who also presents with maxillofacial injuries can be transferred to the specialized center after execution of, first, a maxillofacial diagnostic screening performed by axial computed tomography (CT) scans of the maxillofacial region (or cranial radiographs in three projections and cervical spine radiograph in the

absence of CT) and without any treatment needed for injuries in other parts of the body.

- Scheduled transfer

In cases of isolated maxillofacial trauma (with no involvement of other areas) but with clinical signs and symptoms leading to suspected skeletal injuries of the maxillofacial area, evaluation of the patient in the receiving hospital by means of axial CT scans of the maxillofacial region (or cranial radiographs in three projections and cervical spine radiograph in the absence of CT) will be handled as follows:

Single or multiple surgical fractures will be managed by transfer to the reference center, after direct telephone contact, mainly instead of waiting for a bed.

Nonsurgical compound fractures will be managed by any necessary specialist consultation in the receiving hospital or by scheduled outpatient visit to the specialist center, at the discretion of the treating physician.

Finally, in case of negative CT scans for maxillofacial fractures, no specialized treatment is given, but, if necessary, an outpatient visit is scheduled at the request of the emergency attending physician. In this way, during the first 2 years of use of this telemedicine system, it was possible to avoid unnecessary and expensive transfers of 50% of the patients evaluated using PATATRAC.<sup>[7]</sup>

At the University of Medicine and Dentistry of New Jersey in Newark, digital radiography is obtained using General Electric Patient Archiving Communication System Software. This software has gained widespread use, based on its high-quality imaging, ease of use, and portability. The images can be then downloaded on the computer directly in a joint photographic expert's group format. In smartphones, these images can be downloaded quickly and viewed in Microsoft PowerPoint.<sup>[8]</sup>

Aziz and Ziccardi in 2004 demonstrated using smartphones for downloading images from the hospital archiving system to the resident's phone and then E-mailing or texting them for immediate review. In 2012, Kaltman *et al* describe the use of smartphones for virtual rounding between residents and faculty. They considered it as a efficacious and viable method because it provides real time interaction, as the residents were able to formally present the patient to attending faculty in a virtual face to face meeting. The attending is able to view and direct as needed, including the physical examination and postoperative care from a remote location. Hence, virtual rounding method allows the attending surgeon to provide a higher level of care to the patient in multiple location.<sup>[9]</sup>

Maxillofacial residents had to carry torch, handbook for ward reference, and camera in ward. The smartphone which can perform these functions much easier and with less weight to carry decreases the carrying load.<sup>[4]</sup>

Smartphone helps maxillofacial trainee to access health information, clinical management, or drug guidelines with use of apps.

In most of the smartphone touchscreen interface, autofocus facility in camera, fourth-generation wireless network technology with download speed of 12 Mbits/s, various applications on CT and MRI imaging, dental dictionary and professional apps such as AO surgery reference, study app like maxillofacial procedure videos, and viva learning are available.<sup>[5]</sup>

WhatsApp has been used to transfer CT of the patient with maxillofacial injuries to surgeons who are away from the site, for rapid diagnosis. Viber, another popular app, is also used by junior doctors for consultation and reference with seniors. Snapchat use does not show any benefit to the patient according to the literature.<sup>[10]</sup>

Although there are obvious limitations in comparing the results of telediagnosis in different specialties, the majority of papers favor transmission of clinical and radiographic images by E-mail. A study on the diagnosis of facial fractures showed similar results using telemedicine images and direct radiograph visualization. Stephens *et al.* suggested that many patients were being referred for specialized care in orthodontics without a real need for this type of treatment. They stressed that teledentistry could provide a more rational and precise approach to patient referral.<sup>[11]</sup>

Several drawbacks are present relatively to the clinical use of smartphones. It includes patient confidentiality and cost of the device, user get distracted at work, breaching data security, and infection control issue of device itself.<sup>[4]</sup>

Application has revolutionized and continues to evolve. It is up to us to keep up with technology and use it to our advantage in correct way.

## CONCLUSION

Teleconsultation using smartphones is a useful tool for

specialized consultation, diagnosis, treatment, and follow-up in remote areas. It improves triaging which reduces the expensive and unnecessary transfer of patients with maxillofacial injuries. Prevention of oral diseases and improved quality of health care can be provided to areas where access is difficult or there is lack of facilities. With technological evolution, new methods of delivering better health-care facilities can be possible with the help of smartphones.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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