Intraoperative Use of C–Arm Fluoroscope for Location of Foreign Body in Maxillofacial Surgery: Series of Cases

Manoj Kumar Bhaskaran, MDS
Joseph Lijo, MDS
Chinmay Vasant Rao, MDS, FCMFT

1 Department of Oral and Maxillofacial Surgery, Sree Anjaneya Institute of Dental Sciences, Thrissur, Kerala, India
2 Department of Oral and Maxillofacial Surgery, Malabar Dental College and Research Centre, Edappal, Kerala, India
3 Department of Maxillofacial Surgery, Elite Mission Hospital, Thrissur, Kerala, India

Address for correspondence Chinmay Vasant Rao, MDS, FCMFT, Department of Maxillofacial Surgery, Elite Mission Hospital, Thrissur 680007, Kerala, India (e-mail: chinmayrao11@gmail.com).

Abstract

The practice of maxillofacial surgery commonly entails working in anatomically confined boundaries with restricted access that can easily lead to instrument and foreign body slippage into deeper tissue planes and, rarely, be aspirated. The use of postoperative adjunctive radiographic techniques has long been used to locate any such misplaced foreign bodies to attempt removal or track their passage through the alimentary tract. The use of intraoperative computed tomography scanning has recently gained momentum; but the set up may not be easily available in all the operation theaters. As such, a definitive cost-effective technique to locate such objects remains elusive. The authors intend to share their experience with the use of the C–Arm fluoroscope for the purpose of real-time intraoperative location and attempted removal of foreign bodies in three patients. The C–Arm fluoroscope can thus be used as a cost-effective technique for real-time intraoperative imaging, compared with more expensive techniques.

Keywords
► C–Arm
► fluoroscope
► femer Körper
► foreign body
► maxillofacial surgery

The maxillofacial region provides a unique set of challenges with regards to the difficulty of access to the surgical site of concern and a proximity to vital neurovascular structures. The possibility of an instrument or foreign body accidentally escaping into deep tissue planes or into the aerodigestive tract is ever existent. As such, the maxillofacial surgeon should be well prepared with the skill and expertise to deal with such an eventuality.

The C–Arm fluoroscope is an imaging modality that is almost invariably a part of the standard operating suite set up. Most operating theater staff is well versed with at least the basic working of the C–Arm, and thus, its services can be availed in the eventuality of a foreign body being aspirated during intubation or intraoperative escape into the deeper tissue planes. The authors strive to bring to notice their experience in the use of C–Arm for the location and successful retrieval of the foreign body on three separate occasions thus demonstrating the use of this often ignored modality at our disposal. The authors recognize that the C–Arm is in fact often pressed into action from time to time, but not as a routine in most set ups, as such the authors aspire to add to the growing evidence in the favor of the use of the C–Arm; thus encouraging fellow clinicians to follow suit. The availability of the C–Arm and the real-time imaging advantage which facilitates immediate intervention was the reason for the authors to choose the C–Arm fluoroscope as an alternative to serial intraoperative and postoperative radiographs to locate and track the foreign body.

The authors wish to showcase three cases that warranted the use of the C–Arm for the purpose of intraoperative imaging.

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Case 1: Case of prognathic mandible was posted for bilateral sagittal split osteotomy and setback of mandible. After internal fixation according to the surgical plan, prior to closure the surgical field was irrigated with copious normal saline and suctioned. Before starting closure upon general inspection, two orthodontic brackets were noted to be missing from the dentition with possible dislodgement into the pterygomandibular space. Closure was delayed for confirming the absence of the brackets in question (Fig. 1). The C–Arm was used before checking the suction cannula, for fear of the brackets being dislodged into deeper soft tissue planes during the time invested in searching for the brackets within the suction apparatus. The brackets were then located within the suction cannula and retrieved. The closure of the surgical site was then completed uneventfully.

Case 2: A 2-year-old female patient was brought with a palatal degloving injury. The patient was posted for repair of the same under general anesthesia. Preoperatively, she had a full complement of deciduous with mobility secondary to trauma with maxillary right posterior teeth. After intubation, on intraoral examination, the deciduous maxillary right second molar was found missing. The C–Arm was immediately called for and images were captured that showed the tooth in the stomach of the patient (Fig. 2). The parents were informed and the tooth eventually retrieved after serial stool examination uneventfully.

Case 3: Patient was posted for surgery under general anesthesia for the extraction of the third molars, implant removal, and closure of residual posttraumatic palatal fistula. The extraction of the third molars and implant removal from the left parasymphysis region was uneventful. The mucosal lining was then separated along the border of the palatal fistula and the sharp bone was trimmed using a curved bone nibbler, followed by the closure of the fistula.

At closure, the scrub nurse pointed out the missing hinge screw of the bone nibbler. The screw was not located even after a thorough inspection of the surgical field. The C–Arm was then used to visualize the field, and the screw in question was then located within the socket of the right maxillary third molar tooth (Fig. 3). It was then safely removed and the socket resutured.

Discussion

The maxillofacial region is a complex surgical work space, and as such, the retrieval of any foreign body from the area is difficult. The authors have used an isocentric C–Arm for the location of displaced foreign bodies in the three said instances. While the use of the C–Arm is not new in the reduction of fractures by orthopaedic surgeons, its use by maxillofacial surgeons is limited at best, if not nonexistent. A majority of the work has centered on the use of the C–Arm in extending the scope of its use as a routine adjunct in the reduction and fixation of maxillofacial fractures to foreign body retrieval.

The primary aim of the authors was to highlight the use of the C–Arm fluoroscope in almost all operation theater set-ups.

Fig. 1 C–Arm image of region of osteotomy.

Fig. 2 Image showing tooth (red circle) localized in the stomach.

Fig. 3 Screw (red circle) in the maxillary third molar socket.
ups. The portable radiography unit on the other hand may not always be immediately available at the time of the incident. It may also have to be wheeled into the operation theater complex from the radiology suite. The additional time spent in either the manual processing of the film (possibly in a peripheral set up) or in scanning the film back in the radiology suite, can be better utilized. Also, this additional time thus invested translates into the extended exposure of the patient to general anesthesia; also resulting in an escalation of the overall cost of surgery. The most important advantage that the authors wish to highlight in the context of using a C-Arm fluoroscope for the said application is the ability to obtain real-time images. The time lag that may result as a consequence of the time required for the image retrieval from the conventional radiograph film cassette can have significant clinical ramifications; wherein the foreign body moves further deeper along the aerodigestive tract or into deeper tissue planes as a result of attempts at recovery or patient manipulation in the meantime. This can change the position of the object in question and eventually render the radiograph worthless. A fluoroscope on the other hand allows for real-time visualization and localization of the object, enabling the added benefit of perceiving any change in the position or orientation of the object in question relative to the surrounding tissues. The orientation of the beam of the fluoroscope can also be changed to get a more detailed understanding of position of the object which may not be possible in conventional radiograph. If the radiograph was not able to localize the object or had multiple overlapping structures due to restrictive or faulty angulations, a repeat acquisition may be warranted; further extending the time and possibility of complications mentioned above.

A word of caution in the use of the C-Arm fluoroscope is the added radiation exposure that the patient and the operating team may be subject to. The isocentric C-Arm fluoroscope used by the authors was 59 kV and 0.9 mA as against the standard exposure parameters of 3 to 5 mGy entrance surface dose per radiograph for maxillofacial radiography. The International Atomic Energy Agency (IAEA) recommends at least a lead apron use for intraoperative exposure protection for operating staff and patient.8 An important point to remember is that according to the IAEA guidelines, the C-Arm was to be used more as a localizing device and for image acquisition using pulsed exposure setting, thus significantly reducing the radiation dose to both the patient and staff.8

The authors also note the use of cone beam computed tomography (CT) scan unit-based C-Arm prototype.5 The intraoperative CT scan has been shown to have applications in the treatment of isolated zygomatico-orbital fractures7 and can be a possible alternative to the use of a C-Arm fluoroscope. Despite the versatility of the intraoperative CT scan, the cost that such a set up entails remains largely prohibitive. As such, the authors find the C-Arm to be a formidable tool in the hands of the surgical team in such cases.

**Conclusion**

The authors, through these cases, wish to bring to the fore, a seldom tapped yet powerful technique that can be successfully used to locate and subsequently retrieve deeply lodged foreign bodies lost during intraoperative manipulation or maneuvering. The added advantages cited by the authors pertaining to the real-time imaging capability, no time lag in image acquisition, and the verifiability after retrieval affording a reduction of added exposure to general anesthesia make the case for a more routine integration of the C-Arm fluoroscope in cases similar to the one highlighted above. The authors are aware that the C-Arm may in fact often be pressed into action from time to time, and as most Indian set ups are yet to embrace this modality, the authors aspire to add to the growing evidence in the favor of the use of the C-Arm; encouraging fellow clinicians to follow suit.

**Conflict of Interest**

None declared.

**References**