Orthopedic traumatology: a cross-disciplinary choice for a compact C-arm with CMOS flat detector

OEC One CFD at Skaraborgs Sjukhus Skövde Hospital, Sweden.

Skaraborgs Sjukhus Skövde Hospital is a regional hospital in Central Sweden that provides healthcare to about 55,000 citizens. The surgery ward has 14 Operating Rooms (OR) covering 4 areas: urology, orthopedics, gastroenterology, and rhythmology. In 2019, the hospital performed about 10,000 procedures.

Dr. Bengt Karlsson (Orthopedic Surgeon), Annelie Andersson (Operating Nurse), Towe Järlfors (Assistant Nurse), Cecilia Dittmer (Anesthesia Nurse), Jörgen Härdstedt (Chief Nurse)

To address the increasing demand for orthopedic surgery, a multifunctional team composed of the chief nurse, the nurses, the biomedical engineer, and the surgeons was formed to select the most suitable C-arm for their procedures. After a selection process, the hospital chose the OEC One CFD C-arm. The team explains how the C-arm has supported the orthopedic surgery activity since its installation.

Dr. Bengt Karlsson explains his surgical activity with the OEC One CFD: *"My specialty is traumatology. I treat all types of fractures, with the exception of pelvis and spine injuries, and in all my procedures, I use fluoroscopy. I perform about 5 to 6 operations per week, and for half of them I use the OEC One CFD C-arm. I have been using it for about one month long for upper extremities, a couple of pediatric cases, and for hand surgery.*

OEC One CFD has several functionalities that I appreciate and use. In shoulder surgery, I can rotate the C-arm to get an overscan of more than 45°, up to 55°, to take an AP view. The image quality is very good, and I can see the tubercle lines of the humerus and check that the prosthesis is well centered. If the tubercles don't move when I rotate the shoulder, it confirms they are firmly attached. I have a clear view of the cortical structures of the bones, which is essential for fracture reduction in trauma surgery. OEC One CFD functions very well when I use it for supracondylar fracture reduction in children. The image quality is excellent.

This compact C-arm was also selected for its small footprint to work in our small OR. The big monitor attached to the C-arm is very important to me. It saves space and I can raise it to eye level and pull it close so I can work in a comfortable position. The wireless footswitch, that does not interfere with the equipment of the room when we need to move around, is also an additional comfort. The laser aimer is also important to get the C-arm in the right position without taking additional fluoroscopic images. A 21-cm CMOS detector is big enough for upper extremity surgery, as a larger detector would clutter the sterile working space.

We have also had good experience with the Live Zoom feature, which allows the display of small details in zoomed mode without additional dose.

OEC One CFD is a very good C-arm for my traumatology activity. It is compact, easy to use and provides a very detailed image of the anatomy I need to see for my procedures."

Shoulder fracture reduction by hemiarthroplasty

Courtesy of Dr. Bengt Karlsson, Orthopedic Surgeon, Skaraborgs Sjukhus Skövde Hospital, Sweden.

Clinical Challenge

A 72-year-old female patient was admitted for right proximal humeral fracture reduction by hemiarthroplasty with SMR® prosthesis (Lima Corporate).

Procedure

Before starting the procedure, the team displayed the pre-operative 3D CT image of the fractured shoulder (see Figure 1) on the large monitor of the operating room. They then moved the patient on the operating table in reclined chair position. The patient's right shoulder was cleared from contact with the operating table. This gave the surgeon complete access to the shoulder joint including the possibility to test its motion after reconstruction. A headrest was used to stabilize the patient's head and keep the body in a straight-up position. The procedure was performed under general anesthesia.

The surgeon was positioned in front of the patient's shoulder to be able to perform surgery together with his assistant. The C-arm was brought over the patient's shoulder with an overscan of 45°. Fluoro mode was set up at 8 pps as the CMOS detector delivered the image desired for the surgeon, while minimizing dose.

Before starting the incision, the surgeon took a fluoroscopic image in AP view to verify the fracture and the dislocation of the humeral head (see Figure 2). This AP view also confirmed that the patient was in the correct position for surgery. Once done, the C-arm was then removed from the operating field to proceed with the incision. Once access to the humerus was established, the surgeon performed the careful removal of the bone fragments under visual control. Only those that have the tendons of the rotator cuff inserted were preserved. Fragments that are not useful were removed, and the humeral head was resected under visual control.

The next step consisted of preparing the humeral canal to receive the stem of the prosthesis. The proper stem diameter was then determined with a gauge. The implant stem was inserted and oriented. The size of the humeral head of the implant was evaluated with a gauge. The depth of the stem and the size of the humeral head were verified under fluoroscopy (see Fig. 3). Another fluoroscopy control was performed to check that the humeral head curvature matched with the glenoid cavity (see Fig.4). The trial components were removed and replaced by the final stem. The position of the tubercles within the glenoid cavity were checked under fluoroscopy (see Fig.5) using the Live Zoom feature to confirm it (see Fig. 6).

Functionality of the muscles of the rotator cuff was checked by performing internal–external rotation under dynamic fluoroscopy recording. Once the attachment of the tubercles was confirmed, the incision was closed.

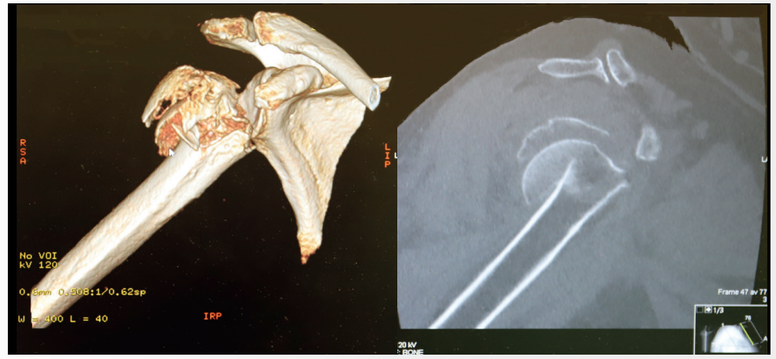


Fig.1: pre-op CT scanner 3D rendering (left) and sagittal view (right) of proximal humeral fracture

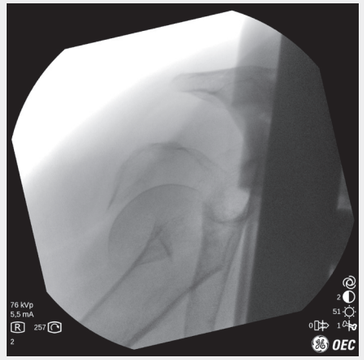


Fig.2: AP View of proximal humerus fracture

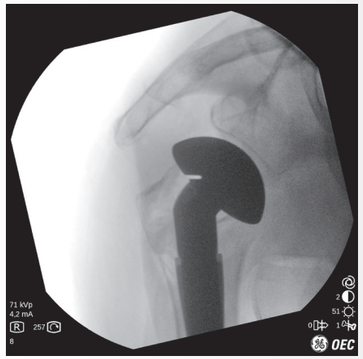


Fig.3: AP View – humeral shaft and head gauge control

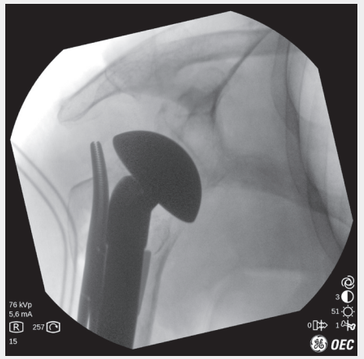


Fig.4: AP View – control of the match of the humeral head gauge with the glenoid cavity

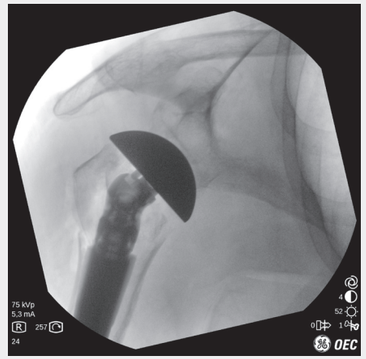


Fig.5: AP View – control of shoulder reduction with final implant

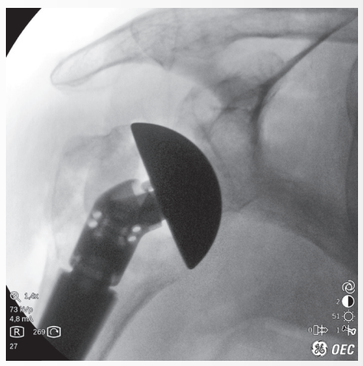


Fig.6: Live Zoom acquisition of final implant with the glenoid cavity

OEC One CFD - A Nurse's choice

Jorgen Hardstedt, Chief Nurse

Chief Nurse Jorgen Hardstedt has been working as an OR nurse for many years. He now manages the orthopedic OR: staff scheduling, the organization of the material and equipment, as well as the instruments needed for special operations. The orthopedic procedures are performed across five operating rooms. The ward is equipped with five C-arms that are shared between the various activities (pacemakers, endoscopy, and orthopedics) and two G-arms that are dedicated to hip fracture reduction.

Can you explain how the OEC One CFD C-arm is assisting management of your operating rooms?

In our process for the selection of a new C-arm, the surgeons defined the level of image quality they need, and the nursing staff looked at the practical aspects of the manipulation of the C-arm. Our orthopedic OR is about 36 m². We want to keep the room very clean and uncluttered. One main criterion for the choice of the OEC One CFD is its 'All-in-One' compact design. The OEC One CFD C-arm is light and easy to transport from one room to another.

Another important point for the nursing staff is the ease of use of the C-arm. It is even more important for our trauma patients. We wanted a C-arm with a user interface that is easy to work with. To start taking images, we don't have to choose a program, we just plug the C-arm in and it's ready to go. We don't even need to enter the patient file; we just take pictures during the procedure. If we want, we can complete the patient file afterwards. The wireless footswitch is also important: it reduces the risk of tripping hazard due to cords or contamination.

We use the laser aimer to center the C-arm over the patient. If the doctor forgets to turn it on, we can activate it from the Touch control panel. We can orientate and turn the image. The Live Zoom feature can be activated like on a smart phone, which makes it intuitive and easy.

For some procedures, we need to switch the C-arm to the contralateral sides. With the OEC One CFD C-arm, it is very easy as we can unplug the C-arm for 5 minutes without turning it off, while we change sides and plug it back in.

With the CMOS flat detector, the image looks good without needing to choose a protocol or adjust the X-ray loading factors to a specific anatomy. The OEC imaging software does it automatically. These are small things, but they significantly improve the workflow, and when you use the OEC One CFD C-arm every day it makes all the difference.

OEC One CFD - A regular user for orthopedics department

Towe Jarlfors, Nurse

I love the fact that it is one piece of equipment with most of the controls located in the same place on the tablet, so I don't need to keep going back and forth between the C-arm and the workstation. I know that I will find all the controls I need on the tablet, and so I just go there to do what I need to do.

The green laser aimer helps to position the C-arm over the patient. I like to be able to turn it on from the tablet in case I need it without asking the surgeon or his assistant in the sterile field. When I position the C-arm with the help of the laser aimer I have noticed that we need to take fewer images and, therefore we reduce the radiation dose.

Before bringing the C-arm over the patient, I apply light tension to the brakes. The surgeon can adjust the C-arm to get the right angle. The C-arm is very stable and stays in place. The surgeon can find the right angulation himself, whereas previously I had to do it. It was more complicated to understand what angle the surgeon needed and in what direction I had to maneuver the C-arm to get it.

The wireless footswitch is nice and easy to clean.

OEC One CFD - A Biomedical Engineer's choice

Andreas Magnusson, biomedical Engineer

Andreas Magnusson is the biomedical engineer in charge of the mobile C-arms used in the operating rooms.
Mr. Magnusson explains what criteria he considered for the selection of OEC One CFD for trauma orthopedic surgeries.

"When we select new equipment, we consider the cost effectiveness, the ease of use, and the performance of the product. We work collectively with the physicists and the clinical staff to select the best C-arm for the activity. We asked the different manufacturers to come over for one week of demo with their C-arm so it could be tested by the different members of the team.

Our physicists were involved in the evaluation of the radiation dose. They concluded that the level of dose for OEC One CFD was low compared to other C-arms. This is one benefit from the CMOS detector: high image quality at low dose. It was one of the criteria of choice among the different brands of C-arms we tested.

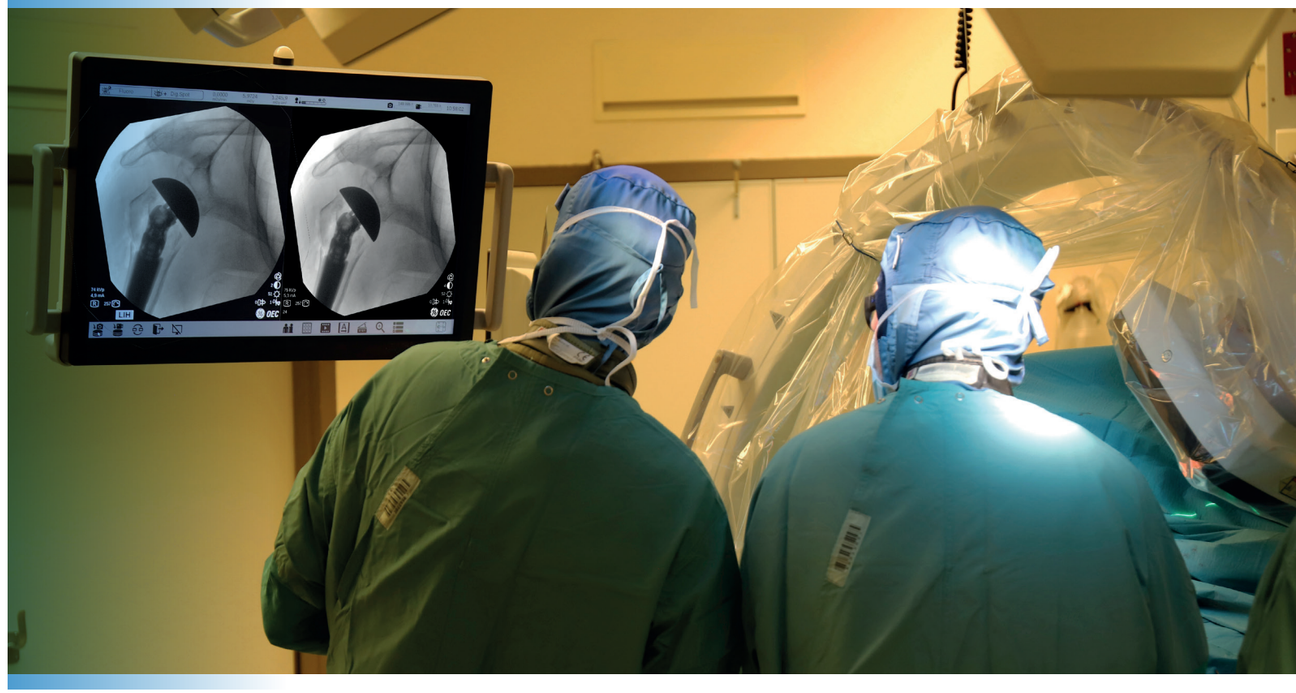
From the technical standpoint of the biomedical engineer, we wanted to select the C-arm with the best compromise between image quality and ease of use. If the user interface of the C-arm is cumbersome, it doesn't matter how good the image quality is. The operating room is an increasingly complex environment, with an increasing amount of equipment to be used by the staff. New equipment should be very intuitive to use without additional stress.

The OEC One CFD was convincing in that sense: the menus have large and easy-to-understand icons, and I was also able to set up the OEC One CFD C-arm quickly within the hospital network.

The 'All-in-One' compact design is important for us. It is an improvement not having the C-arm mainframe and a separate cart for the video monitor that has to be moved from one OR to the next. In our orthopedic activity, there is no need for the extra monitor cart because we can connect the C-arm to any external monitors in the OR. We like this configuration because it avoids the need to handle the monitor cart and reduces the congestion of the operating room with equipment and cables.

When we tested the image quality, I knew that surgeons want to see fine details such as the cortical bone lines or the fracture lines. We knew that the enhancement of image quality is due to the CMOS digital detector that the team has already been using with the OEC Elite CFD C-arm. Compared to our older C-arms that don't have a CMOS flat detector, the improved image quality was immediately perceived by the surgeons. They say that they can see the very fine details in the bones and the surrounding tissues. This is something that was immediately highlighted by the clinical staff.

In the future, it will be difficult to go for anything other than a CMOS detector. The image quality increased significantly and we benefit from reduced dose."



The statements by GE's customers described here are based on their own opinions and on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist, i.e. hospital size, case mix, etc.. there can be no guarantee that other customers will achieve the same results.