Telestrator Uses in the Cath Lab

This adjunctive imaging technology provides opportunities for educational tools and improved performance in lesion assessment and access.

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A telestrator is a device that allows its operator to draw a freehand sketch over a moving or still video image. Today, telestrators are used in a wide variety of applications, from educational presentations and television broadcasts to telemedicine.[1-3] The telestrator is well suited for use as an educational tool in the operating room or cath lab. It can be used to annotate precise details and convey crucial information to the health care team.

Herein, we describe the use of a novel device created for the purpose of telestrating in the angio suite. A brief description of the technology and setup of the device are discussed, followed by a detailed discussion on the advantages of using a telestrator as both an educational and adjunctive procedural tool in the cath lab. In particular, our experience with the telestrator as a means of enhancing lesion access and crossing is presented.

Figure 1. The TFT device in the angio suite ready for use. The telestrated image can be viewed on the touch screen monitor, or in this case, on the top left monitor from the main monitor bank.

TECHNOLOGY

The Total Image Management System (TIMS) FluoroTrace (TFT) (Foresight Imaging, Chelmsford, MA) is a commercially available US Food and Drug Administration–approved medical device that allows for real-time telestration during live case performance in the angio suite. Patent pending software was created by Foresight Imaging as an add-on feature to the existing platform of the digital imaging and communications in medicine, or TIMS DICOM system.

The TIMS DICOM system uses high-resolution and high-speed video capture boards for converting any medical image or video and sending it to a picture archiving and communication system (PACS). TIMS is able to capture both static images and streaming video at 30 frames per second. With the TIMS system, a live, high-resolution fluoroscopic or angiographic image obtained during the procedure is displayed on a 19-inch medical grade touchscreen monitor.

Using the TFT software, operators can then telestrate (generate an electronically drawn video image) over the selected background image. This telestration is continuously displayed as a graphic overlay on the real-time fluoroscopic video. The telestrated image is viewed on the 19-inch medical grade touch screen monitor as well as any other monitor in the angio suite with the proper connections and for the purposes as described in this article.

DEVICE SETUP AND SPECIFICATIONS

The TFT is easy to set up and integrate into any cath lab or interventional suite. It consists of the TIMS DICOM system, which is composed of a small-footprint

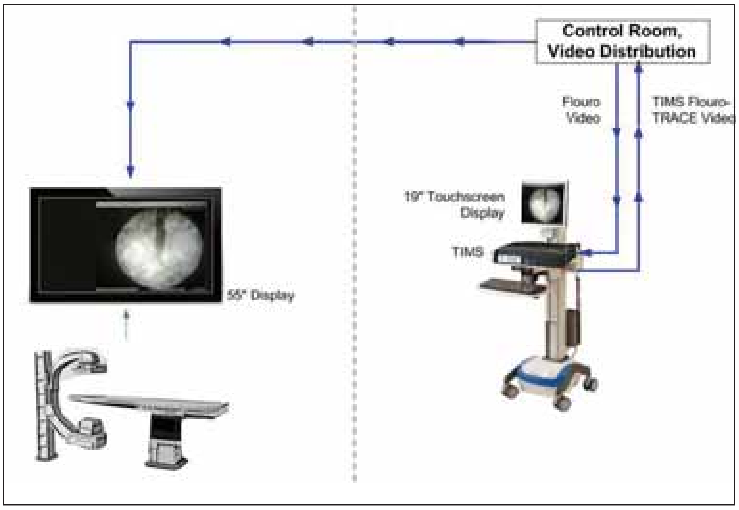

Figure 2. The setup and flow of video input/output for TFT.

computer system that is housed on a mobile cart with a 19-inch touch screen monitor (Figure 1). Video signal to the TFT is achieved utilizing the high-resolution video output from any fluoroscopic device, which is then connected to the high-resolution video input on the TIMS. If desired, the telestrated image from the TFT can be routed to any other monitor utilizing a high-resolution DVI or VGA output connection. In this manner, the telestrated image may be viewed on any slave monitor in or out of the angio suite including the 55-inch, multi-input displays prevalent in modern interventional suites (Figure 2).

Additional features unique to the TFT system include the ability to send the annotated images to PACS for reference as well as the ability to obtain video capture. Video capture is obtained via a USB connection directly from the TIMS computer where one has the ability to save cine loops as AVI files. This is an especially helpful feature when preparing for educational presentations.

TELESTRATION AND THE ANGIO SUITE

Creating the Telestrated Image

Once the operator selects the cine loop or image desired for telestration, a mouse or sterile stylus can be used to create the electronic drawing. Certain features of the TFT can be accessed from a drop-down menu or tool bar at the top of the display using the touch screen. Features of the telestrating software include the ability to choose a specific line width and different colors for the drawing. Other helpful features include the ability to manually erase undesired portions of the telestration or temporarily hide the telestration overlay and return it intact as desired.

The Telestrator as an Educational Tool

Cath labs and angio suites are often considered a lecture hall for medical students, residents, and training interventionists. Much of what the interventional trainee needs to learn is picked up during live case performance, either as an observer or as an operator. Implementation of a telestrator as a teaching tool in the procedure room during the performance of cases is an excellent way to create an interactive learning experience.

There are several scenarios that commonly arise during many interventional procedures during which telestration of the fluoroscopic image can provide clear instruction to the trainee. Verbal communication is often limited in describing and pointing out the abnormal findings on a selected image. Additionally, instruction given to the trainee to direct a catheter or wire into a certain vessel to

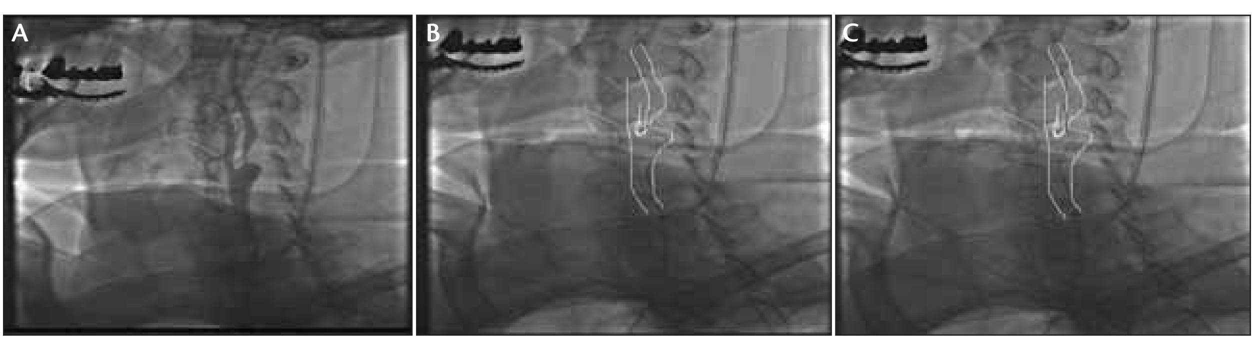

Figure 3. Carotid artery lesion access facilitated by the use of telestration as a roadmap. Unsubtracted image of a selective contrast injection in the left common carotid artery (A). Severe stenosis of the internal carotid artery is seen. The fluoroscopic image with telestration overlay is used as a roadmap to facilitate catheterization of or guidewire access to the target internal carotid artery (B). Note the tip of the wire has not yet crossed the lesion. A fluoroscopic image with telestration overlay demonstrating wire successfully traversing the lesion with target vessel access achieved (C).

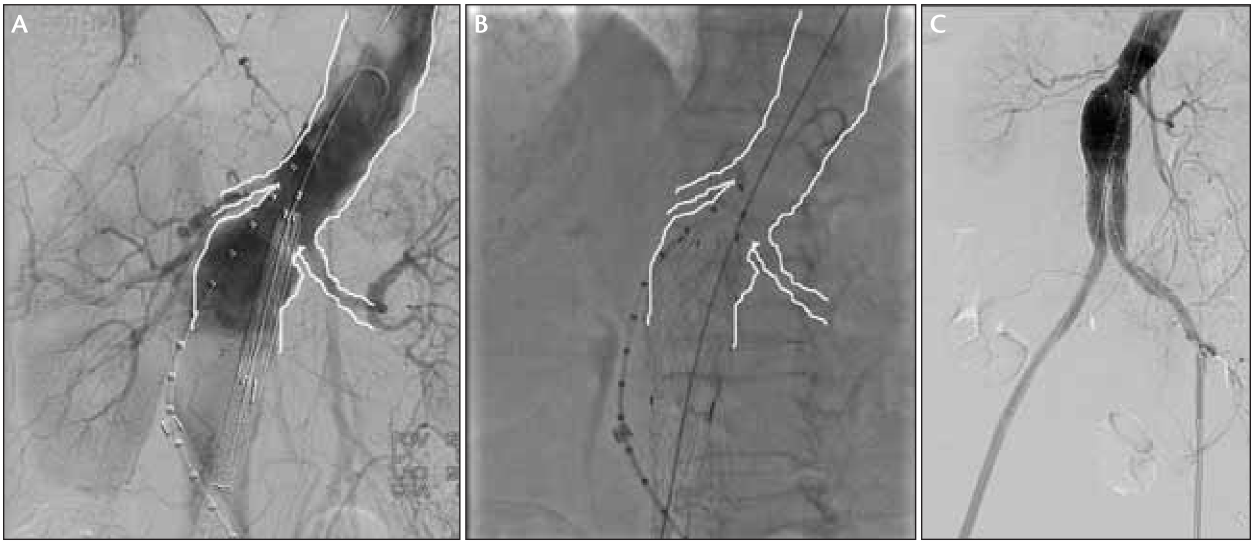

Figure 4. Precise graft deployment facilitated with the TFT. Digital subtraction angiography (DSA) of the abdominal aorta during endovascular aneurysm repair (EVAR) (A). Using the TFT for telestration, an electronic roadmap detailing the aorta and renal arteries was obtained. The target landing zone was chosen to be at the origin of the left renal artery. Note the superior extent of the graft above the intended landing zone. Incidentally noted is fibromuscular dysplasia of the right renal artery. A FluoroSpot image with telestration overlay showing deployment of the main body of the graft after repositioning (B). The superior aspect of the graft is flush against the origin of the left renal artery as depicted on the electronic overlay. A completion aortogram after EVAR specifically showing a patent left renal artery with no evidence of endoleak (C).

obtain access to the lesion or to position a vascular device such as a stent may be unclear with verbal communication.

Annotation of the image using telestration can overcome the limits inherent in verbal communication. During performance of the case, the instructor has the opportunity to electronically and sterilely draw an arrow, line, or circle, etc., depicting the abnormal finding. The ability to communicate by drawing a roadmap or vascular route for the trainee to follow in order to achieve better access to the target lesion can be very helpful. Additionally, the instructor may telestrate the desired target for precise positioning or deployment of a vascular device such as a stent or inferior vena cava filter. The trainee's precision in deployment can be evaluated based on adherence to the telestrated image.

The Telestrator as a Procedural Tool

The TFT allows the operator to create a real-time overlay tracing or electronic roadmap to facilitate lesion access for the performance of many different interventional techniques. Any procedure requiring precise localization of a vascular device or selective catheterization of any branch vessel could be facilitated by creating a telestration using the TFT. Specifically, in order to obtain initial guidewire access across a lesion, a telestration of the vascular anatomy is created as a roadmap, aiding in successful catheterization (Figure 3). Furthermore, the TFT has been very useful in creating a roadmap for localizing the aortic bifurcation to get "up and over" in order to gain access to the contralateral side. See Figure 2 on page 46 for additional information on the concept of localizing the aortic bifurcation.

Procedures such as EVAR (Figure 4), renal artery stenting, or any peripheral arterial or hemodialysis interventions can be facilitated by the TFT. Accurate placement of stents or stent grafts to treat vascular disease is technically challenging. Imprecise deployment may result in serious complications. The telestration overlay serves as a unique way to accurately and reliably position a stent or stent graft while confidently maintaining lesion access to avoid serious complications and obtain optimized device placement (Figure 5). Obtaining lesion access and the positioning and deployment of a vascular device can be performed while utilizing the telestrated roadmap during live unsubtracted fluoroscopy.

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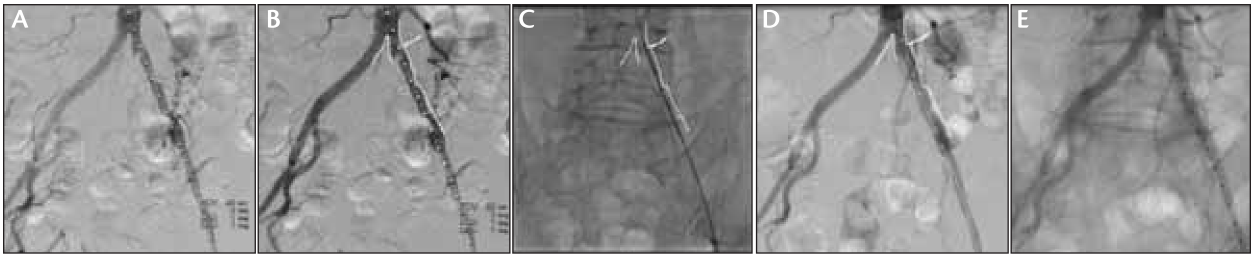

Figure 5. Stent positioning and deployment utilizing telestration. Pelvic DSA demonstrating left common iliac artery disease (A). Pelvic DSA with telestration overlay created using TFT depicting the abnormal anatomy; note the oblique line depicting an acceptable proximal landing zone for stent placement (B). Unsubtracted FluoroSpot image obtained while positioning the stent based on the telestration (C). DSA with telestration overlay showing precise stent deployment (D). Same image as in panel D, but unsubtracted and with removal of the overlay (E).

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Despite advances in roadmapping technology, the options available on many of today's dedicated angiography units can be limited by patient motion and misregistration artifacts.[4] Three-dimensional imaging and navigational tools are currently being investigated and increasingly being implemented into the modern angiographic operating room. Technologies such as centerline navigation, fluoro computed tomographic scanning, and registration of axial imaging with angiography enable better procedural planning and execution.[5,6]

These technologies are limited due to costs, availability, and ease of use. The TFT is also limited by variation in vascular position related to patient respiration, patient movement, or shifting of the table as in standard DSA roadmapping. However, recognition of misalignment of the TFT telestrated overlay can easily be overcome as a result of the ability to draw in anatomic landmarks as well as vascular structures to allow realignment utilizing live fluoroscopy of the TFT image before obtaining access to the lesion or deployment of the chosen vascular device.

In addition, the TFT can serve as an adjunct to the standard DSA roadmap. For example, one may acquire a DSA roadmap of a desired vessel for selective catheterization or treatment, but during the course of the procedure, the image could become distorted due to motion, thereby limiting the operator's vision. If a TFT roadmap had been created as well, the image distortion would no longer be a factor, as the roadmap can be visualized during live unsubtracted fluoroscopy. With the confidence and precision generated using telestration during interventional procedures, procedure time, contrast load, and fluoro dose could be expected to decrease.

CONCLUSION

The TFT is a novel device created for the purpose of telestrating during fluoroscopically guided procedures. The device can be integrated into any angio suite and is easy to use. Incorporation of a telestrator as an adjunct to existing technologies during interventional procedures has the potential to improve educational capabilities in the cath lab and result in better patient care and procedure outcomes by facilitating lesion access and treatment. ■

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