

DIAGNOSTIC IMAGING EUROPE

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Special Focus

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Enterprise-wide 3D assists radiology/surgery workflow

Thin-client solutions avoid network bottlenecks, improve accessibility to user-friendly 3D reconstruction tools

It is becoming increasingly important in modern distributed healthcare enterprises to view and manipulate 3D images. CT and MRI systems are creating ever larger volumes of data. This has increased the need for fast and efficient 3D post-processing tools, such as multiplanar reconstruction, volume rendering, curved reformatting, and volume measurement.

As use of these 3D tools becomes accepted as the standard way of working, they will need to be made available to radiologists, cardiologists, and neurologists; physicians in the accident and emergency and intensive care units; and interventionalists and surgeons. Image distribution may be required outside

the hospital as well. Pure 2D web-based clients will cease to be acceptable. Remote users will want to have the same 3D functionality regardless of where they are working.

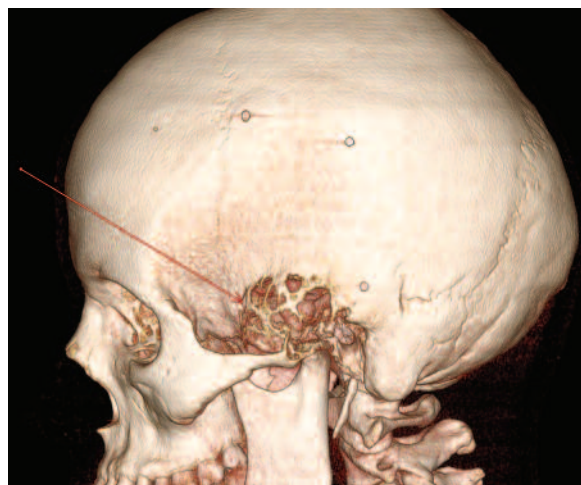


FIGURE 1. Cystic tumor in lateral skull base affects stability of temporomandibular joint. Whole lesion can be seen on 3D volume-rendered image of skull (arrow).

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Many hospitals currently have a centralized PACS and a number of loosely integrated workstations for 3D review and post-processing. Data are sent from imaging modalities to the PACS and then forwarded to (or prefetched by) selected workstations. Radiologists and physicians review the images on these workstations. A multitude of key views or processed images are then generated. These are returned to the PACS and/or selected recipients as snapshots and/or cine loops.

This “isolated workstation” paradigm has many problems. Original data are not always available where needed, a significant amount of time is spent sending original and processed data between different workstations and servers, and additional quality control is required to ensure that all diagnostic images generated are archived and transferred correctly. Workstation hardware may be too slow or have insufficient memory to review large 3D studies, while updated versions of software or optional application packages may not be available at every workstation. Referring physicians will be able to review snapshot images, but they will not be able to use these views as bookmarks into the original data.

Hospital IT infrastructure used to provide medical imaging data must meet certain minimum requirements. One frequent problem is bottlenecks in the data flow. Three-D technologies produce thousands of slices per patient and per procedure. Because the complete data set is sent to the workstation, network traffic is inevitably heavy. The infrastructure consequently has to be optimized from start to finish; that is, from

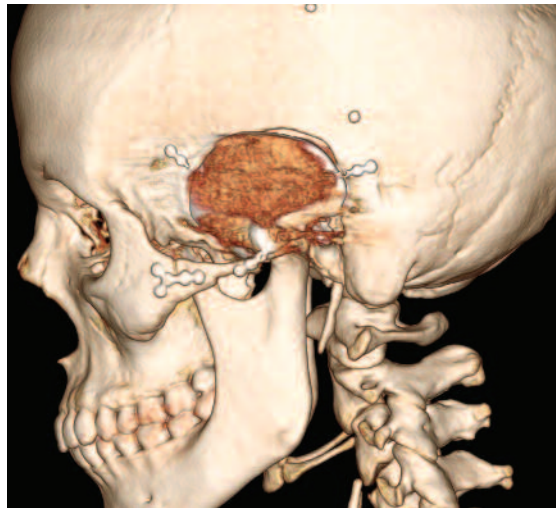


FIGURE 2. Postoperative CT scan shows titanium implant that replaces left lateral skull base.

the imaging modality through to the user’s PC or workstation.

A fully integrated 3D thin-client solution provides full and consistent 3D capabilities throughout the entire hospital enterprise, even on legacy and standard PCs and workstations.

All DICOM data remain on the server—there is no data transfer prior to launching the 3D viewer. All operations are performed directly on the server, and all functions can be accessed

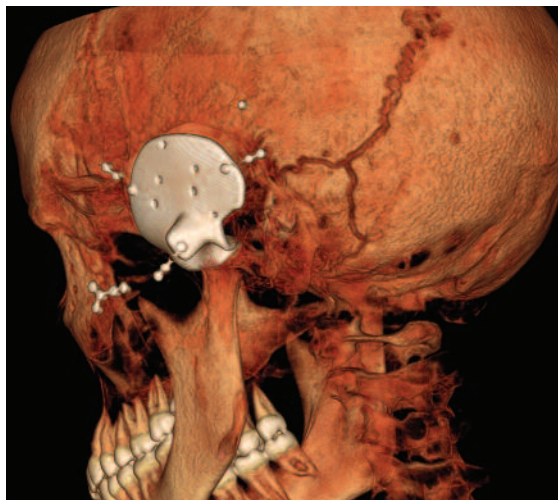


FIGURE 3. Applying different color template renders bony material partly translucent and titanium implant opaque; this facilitates clinical assessment of implant position.

instantly from anywhere in the enterprise via thin clients.

Thin clients require only moderate network resources during actual user interaction. Data are not sent back and forth, and so time and resources required for data transfer and quality assurance are greatly reduced. Network resources are used more evenly throughout the workflow, and peak bandwidth problems are effectively eliminated. Using central servers and web-based deployment makes it easier and cheaper to maintain data and software consistency.

Thin clients also allow users to access and share processing resources in a much more efficient

manner than conventional “fat client” applications. The deployment of 3D workstations throughout all surgical departments, for example, incurs a high initial investment, yet the frequency of cases that actually need advanced 3D functions is low. This does not represent cost-effective utilization of the workstations. Deployment of thin-client software, on the other hand, does not require great capital expenditure because existing hardware can be reused. Surgical users can also share a pool of “floating” user licenses. This is especially useful in a large hospital or in hospitals that are distributed over several locations.

Good thin-client solutions provide the exact same user experience everywhere, regardless of location. Role-based protocols let users interrupt and continue working anywhere, any time. User-specific “roaming profiles” store user-specific preferences (i.e., preferred font size, default tool sets, etc.) and make them available consistently on all client machines. Roaming sessions are similar to the hibernation feature of a laptop. For example, you can do postprocessing on a complex case and hit “save ses-

sion.” Later, you can continue working on that same case and session from anywhere in the world by restoring that session with a click of the mouse. You can even share sessions with coworkers; e.g., a 3D technician can do some standard postprocessing, and a radiologist can use the postprocessed data and still fully manipulate and fine-tune the results.

SURGICAL SOLUTION

Multislice CT scanners are used extensively for surgical planning and postoperative monitoring. It should ideally be possible to compare pre- and postoperative scans rapidly and efficiently in the surgical department. Thin-client software typically provides easy-to-use tools for quick 3D navigation and visualization. This allows 3D solutions to be deployed across multiple departments and disciplines with only minimal training.

The benefits to surgery of 3D imaging tools can be seen from the following example. A 22-year-old patient was admitted to the hospital with a benign cystic tumor in the left lateral skull base that affected the mechanical stability of the temporomandibular joint.^{1,2} The

whole lesion was visualized on 3D volume-rendered images of the skull (Figure 1). A patient-specific titanium implant was designed and manufactured on the basis of these images.

The outline of the implant was used as input for an intraoperative navigation system.³ Small titanium marker screws were inserted in the perimeter of the TMJ under local anesthetic. These marker screws were used to register the virtual model of the implant outline with the current position of the patient during surgery. The outline was transferred to the patient’s skull, providing guidance for the surgical removal of the cystic tumor and surrounding bone. The implant was then inserted and secured to the skull using standard osteosynthesis plates.

A second CT scan was performed postoperatively. Some advanced visualization functions were used for this imaging assessment (Figures 2 and 3).

The radiology and surgery departments involved in this case were located on separate campuses of the Charité Hospital in Berlin. Data were shared easily via thin-client technology, despite this distributed

environment. Visualization and postoperative assessment were performed remotely over a distance of more than 15 km using a standard broadband connection. The workflow, performance, and tool set were the same for all users.

A thin-client solution for 3D image reconstruction removes technical barriers between different modalities and departments. It creates a more homogeneous and manageable IT infrastructure, and helps to maximize the use of existing imaging and IT resources. Radiologists, surgeons, and other subspecialists have immediate access to identical data sets and to large studies and reports. This access is possible throughout the entire hospital enterprise network, improving diagnostic efficiency, optimizing patient care, and increasing productivity. ■

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