MRI Scanning by Remote Control.

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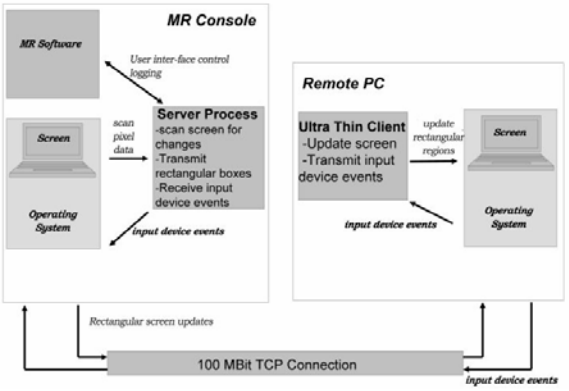
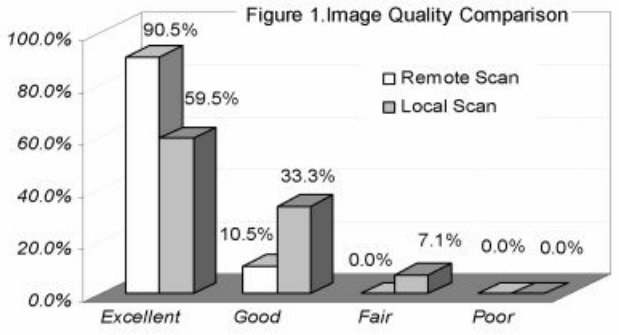
Background: MRI represents powerful but complex technology which sometimes requires specialized operational and interpretative expertise. Currently, there are insufficient trained physicians and technologists to meet the growing clinical need, particularly for cardiovascular applications. We sought to increase operational efficiency and service within a closed institutional network by providing specialist scanning support via remote control from a central hub.

Method and material: For remote scanning, a personal computer (PC) running Windows XP and located 0.5 miles from an in-patient MRI scanner and 6 miles from an outpatient scanner was used to emulate the local MRI operators console. The remote console (RC) was slaved to the local console (LC) via VNC (virtual network computing) [1] software, and connectivity was mediated via the institutional intranet with a maximum bandwidth of 1 mega byte (MB) per second. 30 patients (14 adults and 16 children) underwent cardiac (12) and /or vascular (30) MRI scanning by a remote operator, using a 1.5 Tesla machine. The resulting images were compared to those of 30 patients, matched for age and type of study, who underwent MRI scans in a conventional manner by local operators. Subjective criteria for image quality, motion artifact and vessel visibility (pulmonary and abdominal branches) were graded on a 4 point scale. The differences in above measurements were assessed using a Wilcoxon signed rank test.



Results: Image quality was rated excellent in 90.5% (38/342) of remote scans versus 59.5% (25/42) in the control group (p-value< 0.01, figure 1.). Motion artifact was not scored significantly differently (p-value = 0.11) between the two groups, and there was no significant difference in the duration of the scanning procedures between the two groups (p = 0.98).



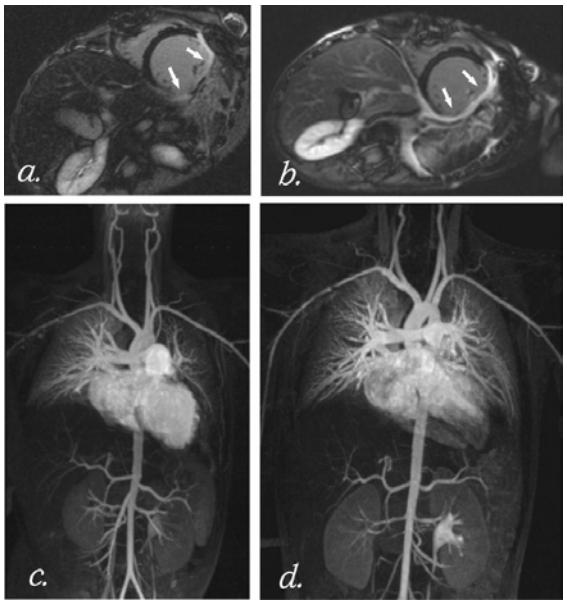


Figure3. ***a.-d.*** 5 year old female patient with high-grade sarcoma of the myocardium involving the circumflex coronary artery. Surgical resection was complicated by *myocardial infarction*. Remotely controlled delayed hyper-enhancement imaging of the myocardium ***(a)*** and contrast MRA ***(c)*** were performed within one month of resection. Extensive transmural hyper-enhancement is present in the lateral and infero-lateral left ventricular wall (*arrows*), consistent with infarction in the circumflex distribution.
Locally controlled delayed hyper-enhancement imaging of the myocardium ***(b)*** and contrast MRA ***(d)*** were performed eight months after resection. Again, extensive transmural hyper-enhancement is present in the lateral and infero-lateral left ventricular wall (*arrows*). Both studies were scored highly diagnostic quality.

Conclusions: we have successfully implemented remotely controlled MRI scanning in complex cardiovascular cases. It seems likely that such functionality will evolve rapidly, such that advanced techniques, supervision and training can be provided independently of physical separation, and ultimately on a global basis. The implications for future clinical practice are profound.

Reference: 1-Richardson T, Stafford-Fraser Q, Wood KR, Hopper A. Virtual Network Computing. IEEE Internet Computing 1998; 2(1): 33-38.