Resolution, SNR, Signal Averaging and Scan Time in MRI for Metastatic Lesion in Spine: A Case Report in a 74 Years Old Patient

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Abstract

Background: MRI image quality is compromise between resolution, scan time, signal averaging and signal to noise ratio (SNR). Any compromise in any of these parameters can lead to poor quality images that can lead to misdiagnosis. The higher the image resolution, the better the small pathologies can be diagnosed, thus it is the goal of imaging a good quality scan by using a standardized protocols.

Case Presentation: We present a case of 74 year old man with severe lower back pain. His initial MRI did not reveal any significant pathology done 15 days ago; however a repeat MRI revealed metastatic involvement of the lumbar vertebrae.

Conclusion: Standardized MRI protocols have been developed after much research to optimize all the parameters. Any modification in the protocols to reduce image time is hazardous.

Introduction

- In MRI the resolution is determined by the number of voxels in a specified field of view.
- The higher the image resolution, the better the small pathologies can be diagnosed.
- Resolution is directly proportional to the number of voxels.

Resolution

- Basic resolution is the number of voxels.
- Basic resolution determines the size of the image matrix.

SNR & Basic Resolution

- SNR is inversely proportional to the basic resolution.
- Increasing the base resolution will reduce the voxel size therefore the SNR of the image will be reduced (Fig 1).
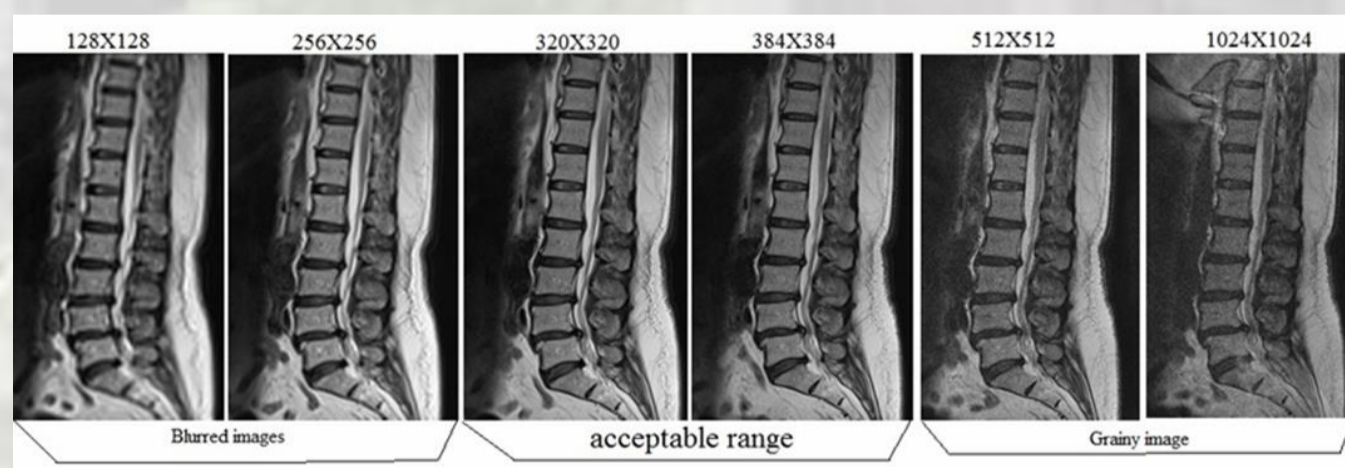

Fig 1: A comparison of the effect of various matrix sizes on image quality when keeping a constant FOV.

- Improvement in scan time leads to a higher resolution and sharper images (Fig 2).
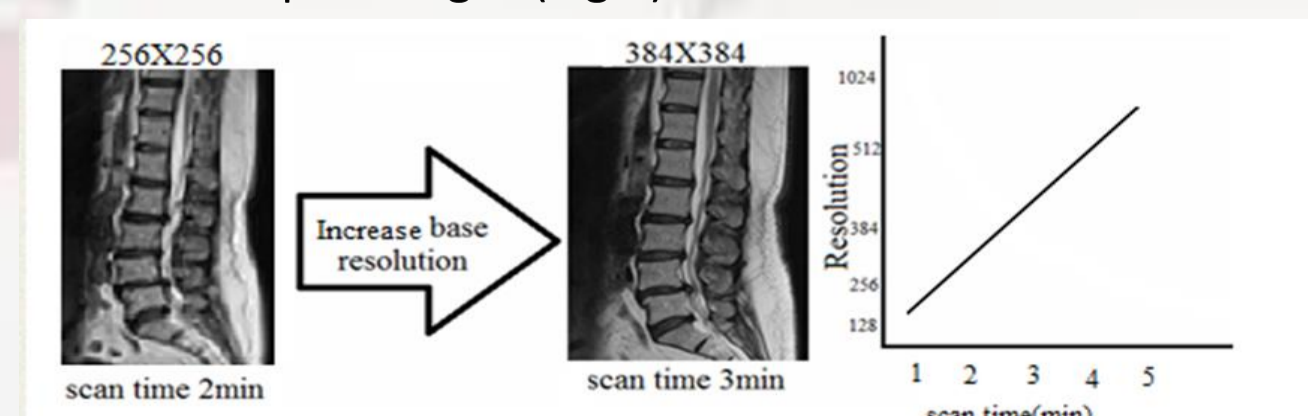

Fig 2: Demonstrates a linear relationship between scan time and resolution

- Decreasing FOV reduces the voxel size and SNR therefore the image becomes sharper.

SNR & Phase Resolution

- Decreasing the phase resolution will reduce the image quality and scan time.
- Reducing the phase resolution will increase the voxel size therefore the SNR will increase considerably.

Case Presentation

- 74-year-old male with a history of severe lower back pain, bony aches, vomiting and abdominal pain. Two MRIs were performed. The first one revealed only one lesion at the L2 vertebra and a single disc bulge, whereas the second MRI correctly characterised the patient as having multiple metastasis.

Fig 3: Left panel shows T1 weighted sagittal images performed with the 1.5 Tesla machine for only 1:10 min, which shows only disc bulges and single lesion at L2 vertebra. The right panel shows T1 weighted sagittal images with a 0.35 Tesla machine but over a period of 4:18 min showing metastatic lesions at multiple levels.
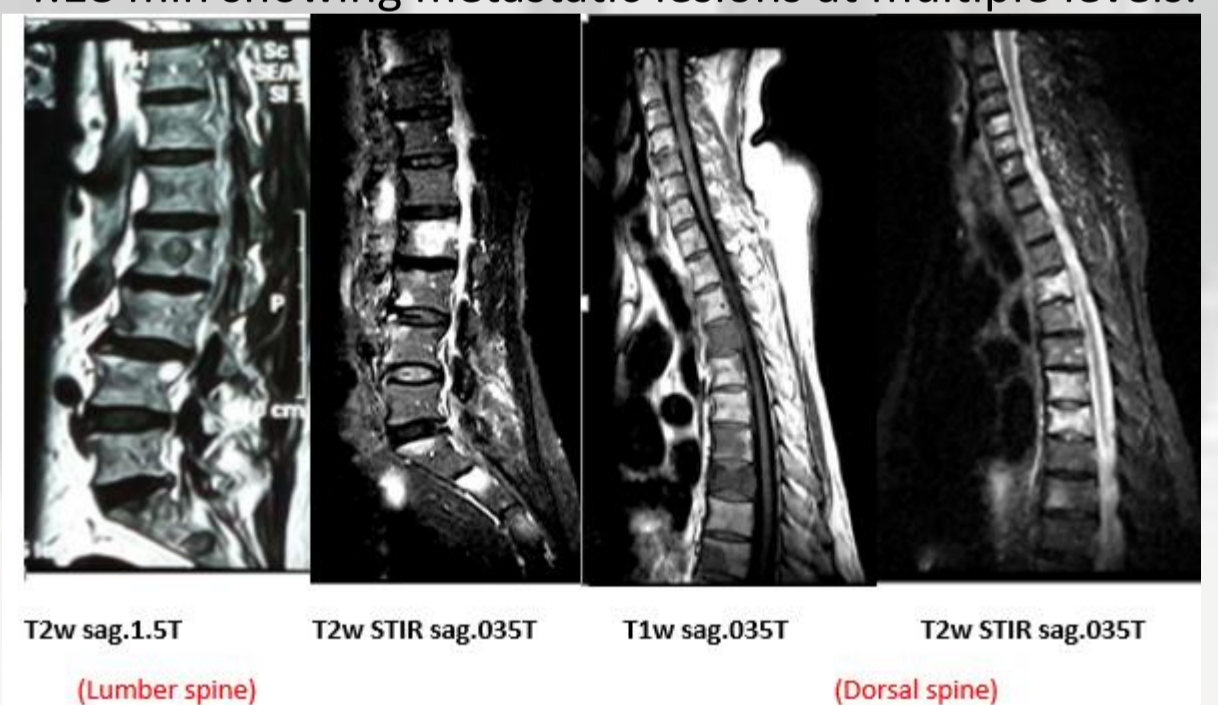

Fig 4: Left panel T2w sag. (performed with the 1.5 Tesla machine for only 1:10 min) & The right panel shows T2 STIR weighted of lumber spine sagittal images & dorsal spine T1w & T2 STIR saggital images of dorsal spine with a 0.35 Tesla machine but over a period of 4:18 min & 5 min, showing metastatic lesions at multiple levels

Conclusion

- Shortening the scan time by decreasing resolution and signal averages leads to blurry or poor quality images which can lead to misdiagnosis.