

Nonenhanced MR Angiography of the Femoral Head using Time-SLIP

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Purpose

Observation of blood supply to the femoral head is significantly important when interruption occurs such as a femoral neck fracture, which easily leads to avascular necrosis (AVN) or transient bone marrow edema. However, the observation of blood supply to the femoral head is anatomically difficult due to their small size and amount of blood supply. Today, observation of the feeding arteries to the femoral head is only performed using DSA. The aim of our study is to selectively visualize small arteries of the femoral head without contrast media [1,2]. Efficacy of time-spatial labeling inversion pulse (time-SLIP) using balanced steady-state free precession (bSSFP) was investigated in the depiction of the feeding arteries to the femoral head.

Materials and Methods

All the studies were performed on 10 healthy volunteers on a 1.5T MRI system (EXCELART Vantage XGV Toshiba, Japan), using a torso SPEEDER coil. The time-SLIP on-and-off alternate acquisition and subtraction method was used in this experiment. For the assessment of proximal femur arteries, the following experiments were performed 1) a tag position and width, where a selective excitation pre-pulse is applied independently of the imaging field, 2) black-blood inversion time (BBTI) or blood traveling time, which is between the selective IR pulse and the imaging pulse. Typical scan parameters were TR/TE=5/2.5 ms, matrix=256x256, FOV=320x330 mm, ECG-gated, and section slice =2 mm. Scan times for imaging the circumflex femoral artery and the retinacular artery were about 5 min and 7 min, respectively. In addition, various other nonenhanced MRA techniques including TOF, ECG-gated 3D partial-Fourier FSE and bSSFP with or without time-SLIP were compared.

Results

Main feeding arteries of the femoral head, the medial circumflex femoral artery and the superior retinacular (capsular) arteries in the bone marrow were visualized. Time-SLIP with bSSFP showed the excellent depiction when the tag was applied on the main trunk of the femoral artery and distal part of the femoral neck, as shown in Figs. 1 and 2, respectively. From the 10 volunteer studies, the appropriate BBTI was between 1500 and 2000 ms, and a longer BBTI decreased the contrast between vessel blood and tissue.

Conclusion

Nonenhanced time-SLIP using bSSFP enables visualization of small arteries of the proximal femur especially when the tag was optimized. Selective visualization of feeding arteries in the femoral head without contrast media is of increasing significance in our aging population.

References

- 1) Miyazaki M, S. Vivian. Radiology, 248:20-42; 2008
- 2) Kanazawa H and Miyazaki M, ISMRM 2002, p140.

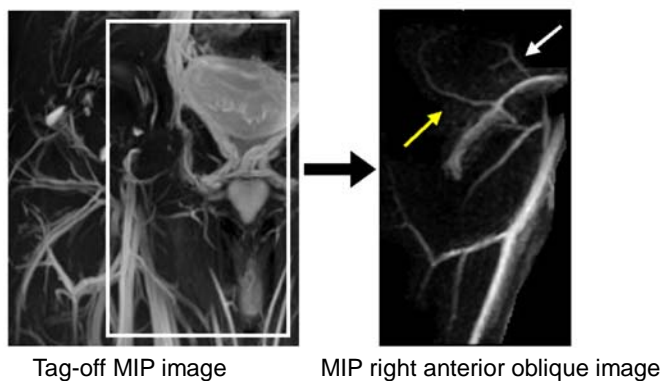


Fig.1) Nonenhanced time-SLIP using 3D bSSFP with an on-and-off alternate subtraction technique. The white rectangular area shows a tag pulse. The subtracted MIP image shows femoral neck branches of medial (yellow arrow) and lateral (white arrow) circumflex femoral arteries without venous superimposition.

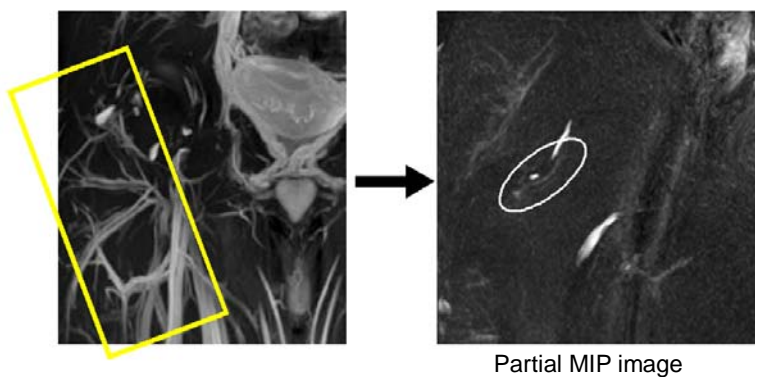


Fig.2) Nonenhanced time-SLIP using 3D bSSFP with an on-and-off alternate subtraction technique. The yellow rectangular area shows a tag pulse. The subtracted partial MIP image shows the superior retinacular arteries which feed the femoral head in the bone marrow (white circle).