

Points

- Carotid plaque MRI using a dedicated, high-resolution surface coil is an excellent modality for evaluating plaque morphology, which is an independent predictor of stroke.
- Carotid plaque MRI can characterize the components of carotid plaque such as lipid / necrotic core, fibrous tissue and cap, calcification and hemorrhage thus distinguishing an unstable plaque from stable disease.
- Carotid plaque MRI thus allows risk stratification in patients with recent TIA/stroke.
- Follow-up carotid plaque MRI allows us to monitor changes in the plaque to assess the response to treatment and to further plan management.

Carotid Plaque MRI

Atherosclerosis is a chronic disease affecting medium and large arteries. The resultant plaque may grow to obstruct the lumen or may disseminate material into the blood stream leading to thrombo-embolic complications. In an attempt to categorize these complex lesions, the American Heart Association has defined a detailed classification of atheroma, based on the histology.

O.	No intimal thickening
I.	Initial lesion with foam cells
II.	Fatty streak with lipid in foam cells and muscle
III.	Preatheroma with extracellular lipid cores
IV.	Atheroma with large extra-cellular lipid pool (core)
Va.	Fibroatheroma with collagen cap
Vb.	Calcified plaque
Vc.	Fibrotic without lipid core
VI.	Complex plaque with surface defect or huge thrombus

Mortality and morbidity from atherosclerosis is largely due to type IV and V lesions which develop surface disruption leading to thrombo-embolic phenomenon. Plaque morphology is now considered to be a predictor of stroke, independent of the degree of luminal narrowing. Modalities to assess carotid narrowing are color Doppler, CT angiography (CTA), MRI angiography

(MRA) and digital subtraction angiography (DSA). Modalities to assess plaque morphology are ultrasound (US) and surface coil MRI with high-resolution. This needs two special 6cm coils, which are placed over each carotid bifurcation region (Fig. 1). Using appropriate high-resolution sequences, exquisite images of the carotid lumen and the plaques are obtained (Fig. 2). It is possible to differentiate between stable (Fig. 3) and unstable (Fig. 4) plaques, evaluate the size of the lipid cores (Fig. 5), and the presence of ulceration, hemorrhage (Fig. 4) and thrombi (Fig. 6).



Fig. 1

Fig. 1: Patient image showing the coils and their placement

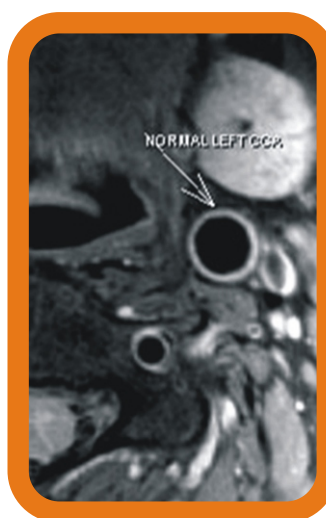


Fig. 2

Fig. 2: Normal carotid artery. Note the normal smooth media and lumen surface.

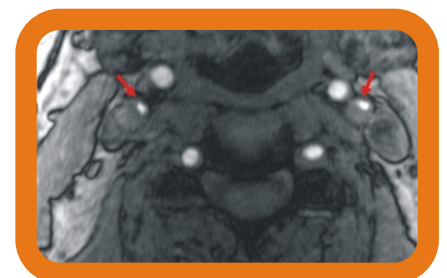


Fig. 3A

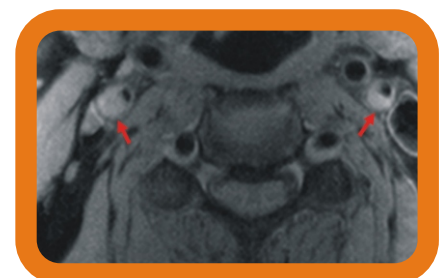


Fig. 3B

Fig. 3 (A, B): Stable plaque fibroatheroma. Both ICAs (A) show luminal narrowing (arrows) with fibroatheromas (arrows in B).

Carotid plaque MRI can be used for follow-up to assess the status of the plaque (Figs. 6, 7).



Fig. 4A

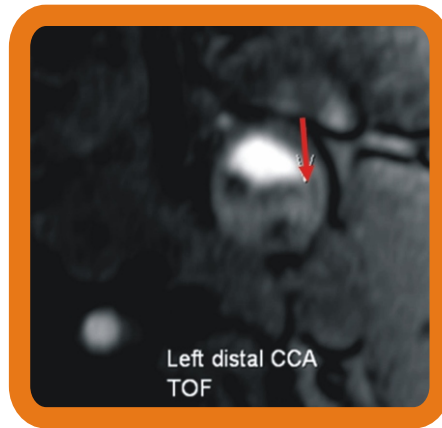


Fig. 4B

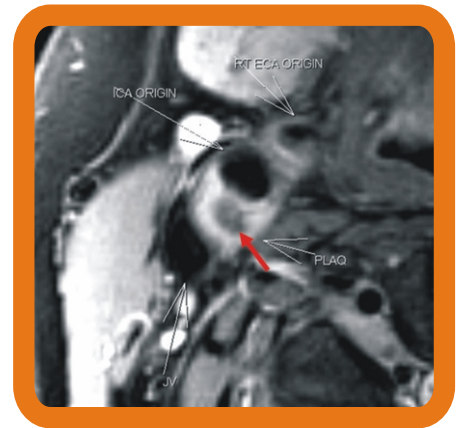


Fig. 5

Fig. 4 (A, B): Unstable plaque. The left ICA shows intra-plaque hemorrhage (A) with a defect in the fibrous cap (B).

Fig. 5: Lipid core. The right ICA shows a necrotic, lipid-rich core (red arrow).



Fig. 6A

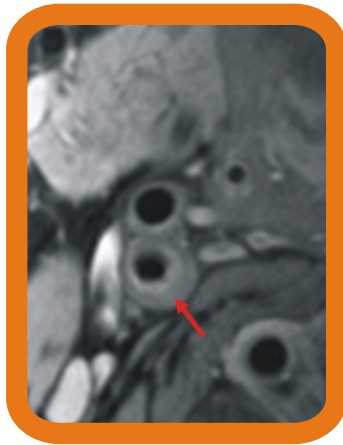


Fig. 6B

Fig. 6 (A, B): Thrombus. The right ICA (A) shows an intra-luminal thrombus (arrow), which regressed to a stable plaque (arrow in B) after three months of aggressive therapy including statins.



Fig. 7A

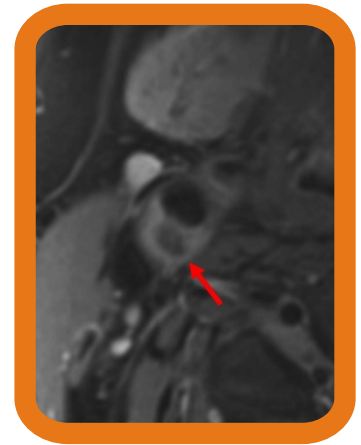


Fig. 7B

Fig. 7 (A, B): Unstable plaque. The right ICA (A) shows a large necrotic, lipid core (arrow), which partly regressed and shrunk (B) after 1 year of aggressive lipid therapy.



Indications

1. In recent TIA/stroke, to assess the status of the plaque. This can be combined with MRI angiography to assess the lumen as well
2. Monitor the efficacy of medical (e.g. statins), which may induce a reduction in lipid core size
3. Monitor disease progression or regression to help plan further treatment (plaque stabilization versus vulnerable plaque)

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