

# 가: 3 Gadolinium

1

2

: 가

: 11 12 (DSA)  
(CE - MR angiography) 1 11

4 , 3 , Buerger 1 ,

가 1 , calciphylactic 1 ,

1.5T (FISP) kg 0.2 mmol gadolinium 3

3 ml

10 ml

10

20

10

4

7

2

가

: 84

16

39

26

3

5.42 ,

3.50

(T - test,  $p < 0.000$ ).

CE - MR angiography

(T - test,  $p <$

0.000)

: 가 3

, Buerger

(1, 2)

(FOV)

가

가

가

, DSA

(3 - 6), plethysmography,

가

가

(Digital subtraction angiography,

(Time of Flight,

DSA )

TOF )

(Phase Contrast, PC

DSA

)

DSA

TOF

가

(7 - 9).

2 TOF

1

2

2001  
2001 8 13

2002 4 17

(Contrast - enhanced MR angiography, CE - MR angiography) (10)  
 CE - MR angiography DSA  
 100% 가  
 (11 - 13).  
 가 CE - MR angiography가  
 DSA

Steady State Precession, TR 7.8 msec, TE 2.0 msec, Flip angle 60 °; FOV 25 cm, Matrix 128 x 256, NEX 1, Slice thickness 3 mm)  
 kg 0.02 mmol gadolinium(Dotarem, Guerbet, Paris, France) 3 ml  
 10 ml gadolinium 10  
 20 10 4  
 MIP(maximum intensity projection) DSA  
 5F Omni (Angioptic Omni

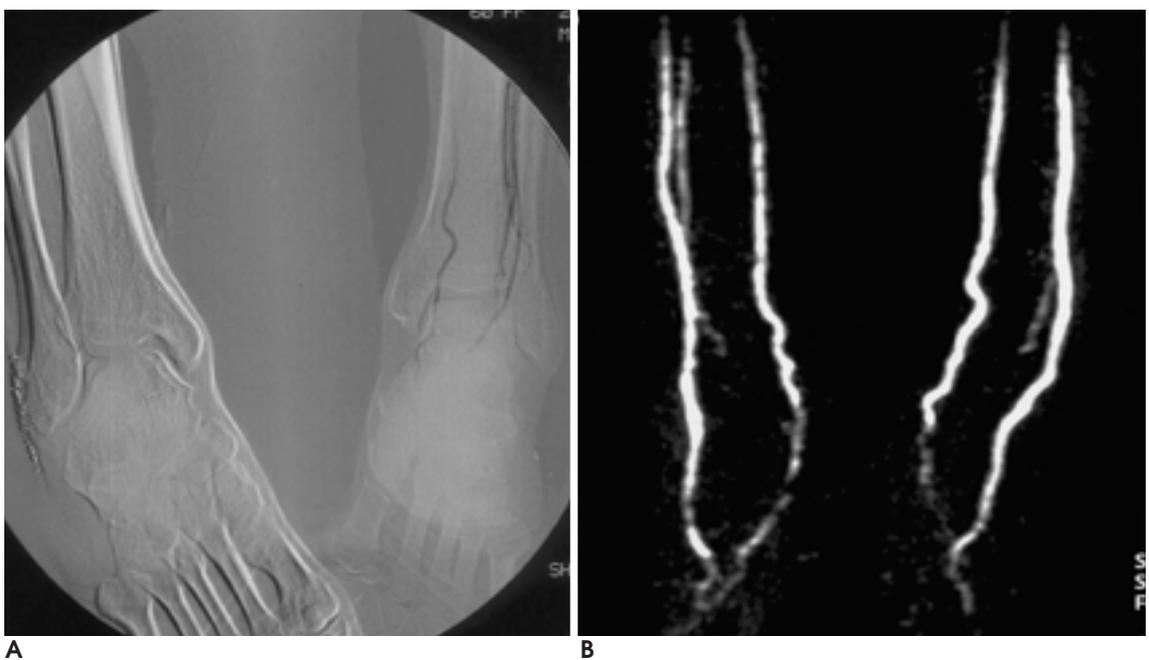
1999 11 2000 6  
 가 11 12  
 가 7 , 가 4 , 49.5  
 (21 - 78 ) . 4 , 3 , Buerger  
 1 ,  
 가 1 , calciphylactic 1 , 1  
 DSA CE - MR angiography 1  
 . CE - MR angiography 1.5T  
 (Magnetom vision, Siemens, Erlangen, Germany) (extremity coil) (head coil)

**Table 1.** Visualization of 84 Arterial Segments with CE-MR Angiography Versus DSA in 11 Patients

Artery	Both	Neither	CE-MRA only	DSA only	Total
Anterior tibial a.	8	1	3	0	12
Distal Peroneal a.	7	2	3	0	12
Posterior tibial a.	9	0	3	0	12
Medial plantar a.	5	2	4	1	12
Lateral plantar a.	4	3	4	1	12
Dorsalis pedis a.	3	3	6	0	12
Pedal arch	3	5	3	1	12
Total	39	16	26	3	84

a.: artery  
 CE-MR Angiography: Contrast-Enhanced MR Angiography  
 DSA: Digital Subtraction Angiography

가 . 3 FISP(Fast Image in



**Fig. 1.** 64 - year - old man with atherosclerotic stenoses in both common iliac arteries.  
**A.** DSA of left ankle shows anterior tibial, posterior tibial, and peroneal artery but in DSA of right ankle, these arteries are not displayed.  
**B.** CE-MR angiography of both ankle shows patent anterior tibial, posterior tibial, and peroneal arteries. Also dorsalis pedis and lateral plantar arteries of both feet are seen.

Flush, Angiodynamic, New York, U.S.A.) 5

, 6

DSA (SX - VA30, Hitachi, Tokyo, Japan)  
35 70 cc 3 15 cc

MR angiography

. PC

가

TOF

2D TOF가

TOF가

3D

2D TOF가

(14).

TOF

T - test

, in - plane flow

, MIP

(stepladder artifact)

(15).

2D TOF

presaturation pulse FOV

FOV CE - MR angiography

11 angiography  
16

12 DSA

84

84

CE - MR

가

(15).

2D TOF

FOV

CE - MR angiography

(Table 1).

CE - MR angiography

3

DSA

48

CE - MR angiography

가 17 (Fig.1), DSA

3

CE - MR angiogra -

CE - MR angiography

gadolinium T1

가

, 가 가 ,

가 TOF

phy

5.41

, DSA

3.50

가 (T - test,  $p=0.000$ ).

CE - MR angiography

(T - test,  $p=0.000$ )

가

, 가

TOF

(17)

phy

가

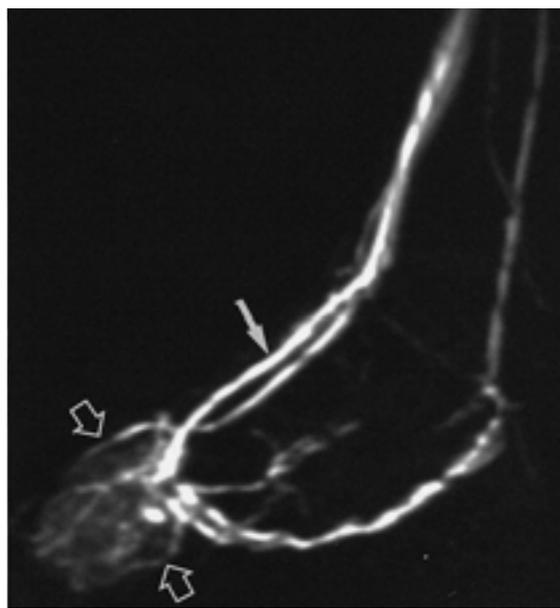
(16) Rofsky

MR angiogra -

CE - MR angiography가



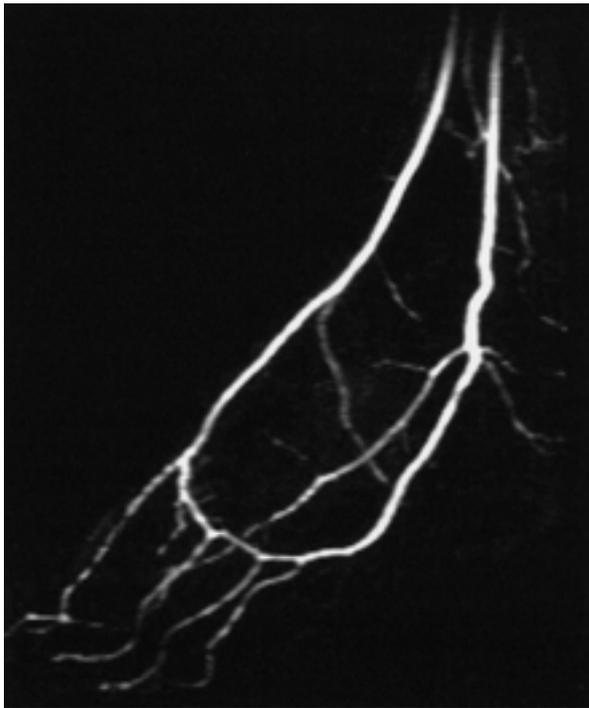
A



B

**Fig. 2.** 19-year-old woman with arteriovenous malformation.

Both DSA (A) and CE-MR angiography (B) show nidus (open arrows) with early draining vein (closed arrow).



**Fig. 3.** 26-year-old man normal volunteer CE-MR angiography acquired with the scan time of 20 seconds shows all seven arterial segments in ankle and foot.

Unger (18) CE - MR angiography 2D TOF  
 DSA 가  
 raphy 가 CE - MR angiography 가  
 가 CE - MR angiography (T - test,  $p=0.014$ ).  
 Kreitner (19) 24 DSA 가 9  
 (38%) CE - MR angiography 가 DSA  
 3 2 DSA CE - MR angiography  
 raphy Calciphylaxis  
 (20, 21),

(22). 64  
 7 가 2  
 . DSA CE - MR angiography calciphylaxis  
 CE - MR angiography 가  
 가 가  
 4 . CE - MR angiography 10  
 , , 가  
 (23).  
 (Fig. 2).  
 Matrix  
 5 20  
 (Fig. 3), 30 , 40 , 50 , 60  
 가 . , 11 20  
 4  
 가 가  
 가 가  
 가  
 3D CE - MR angiography 가  
 DSA 가  
 DSA

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## Evaluation of the Pedal Artery: Comparison of Three-dimensional Gadolinium-Enhanced MR Angiography with Digital Subtraction Angiography<sup>1</sup>

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**Purpose:** To compare the three-dimensional gadolinium-enhanced MR angiography with digital subtraction angiography (DSA) for evaluation of the pedal artery.

**Materials and Methods:** In 12 extremities of 11 patients, both digital subtraction angiography (DSA) and contrast-enhanced MR angiography (CE-MR angiography) were performed during the same week. Among ten of the 11 patients, the following conditions were present: atherosclerosis ( $n=4$ ), diabetic foot ( $n=3$ ), Buerger's disease ( $n=1$ ), calciphylactic arteriopathy ( $n=1$ ) and arteriovenous malformation of the foot ( $n=1$ ). The remaining patient underwent angiography prior to flap surgery. For MR angiography, a 1.5T system using an extremity or head coil was used. A three-dimensional FISP (fast imaging with steady state precession) sequence was obtained before enhancement, followed by four sequential acquisitions (scan time, 20 secs; scan interval time, 10 secs) 10 seconds after intravenous bolus injection of normal saline (total 10 cc), following intravenous administration of gadolinium (0.02 mmol/kg, 3 ml/sec). Arterial segments of the ankle and foot were classified as the anterior or posterior tibial artery, the distal peroneal artery, the medial or lateral plantar artery, the pedal arch, and the dorsalis pedis artery. Two radiologists independently analysed visualization of each arterial segment and the mean of visible arterial segments in one extremity using CE-MR angiography and DSA.

**Results:** Among 84 arterial segments, 16 were invisible at both CE-MR angiography and DSA, while 39 were demonstrated by both modalities. Twenty-six segments were visible only at CE-MR angiography and three only at DSA. CE-MR angiography displayed a higher number of arterial segments than DSA (mean, 5.42 vs. mean 3.50, respectively), a difference which was statistically significant ( $p<0.000$ ). The difference between each arterial segment was not statistically significant, except for the dorsalis pedis artery (t test,  $p<0.000$ ).

**Conclusion:** In that it provides additional information for the planning of treatment of lower-extremity arterial disease, three-dimensional CE-MR angiography is superior to DSA for evaluation of the pedal artery.

**Index words :** Magnetic resonance (MR), vascular studies  
Magnetic resonance (MR), contrast enhancement  
Extremities, MR  
Angiography

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