

1

· · · · ·

: ‘ ’ 4 5mm

가 ,

가 .
: 454 ,

862 .

614 가 , 97 가 , 43 가 , 108 가

T2

3mm 1mm .

가

: 1 ‘

, 73.2%

, 35.0% 27.5% .

8mm

56.4%, 27.1% .

: ‘ ,

가

,
‘ ,

.

‘ ,

가

(1).

9 12mm

(1,2).

가

4 5mm

5

가

‘

,

가 302 , 가 132 9 74
(Table 1). (discoid meniscus)
862
614 , 가
가 97 , 43 ,
가 108
92 ,
21
1.5T (GE Medical Systems, Mil-wau-
kee U.S.A.) T2
(TR/TE = 2500/15,60) T2
(TR/TE = 2500/17,60) 16cm, 256
× 192 matrix 3mm 1mm
가

Table 1. Age Distribution. (n= 434)

Age	- 10	- 20	- 30	- 40	- 50	- 60	over 60 years
Number	1	50	160	94	78	35	16

Table 2. Number of Sagittal Images with Bow-Tie Appearance (#BT) vs Body Width(BW) in Normal Group

BW(mm)\#BT	1	2	3	sum(%)
5	8			8 (1.3)
6	19			19 (3.1)
7	69	2		71 (11.6)
8	62	62		124 (20.2)
9	11	129		140 (22.8)
10		169		169 (27.5)
11		48		48 (7.8)
12		27	5	32 (5.2)
13		3		3 (0.5)
sum(%)	169 (27.5)	440 (71.7)	5 (0.5)	614 (100.0)

Table 2-5
1 (97.7%)

(Fig. 1,2).
73.2% (79/108) 가
35.0% (34/97), 27.5% (169/614)
(Fig. 3-5).

Table 3. Number of Sagittal Images with Bow-Tie Appearance (#BT) vs Body Width(BW) in the Group of Degenerated Meniscus

BW(mm)\#BT	0	1	2	sum(%)
6		2		2 (2.1)
7		11		11 (11.3)
8	1	15	5	21 (21.6)
9		3	12	15 (15.5)
10		2	30	32 (33.0)
11			9	9 (9.3)
12			4	4 (4.1)
13			3	3 (3.1)
sum(%)	1 (1.0)	33 (34.0)	63 (65.0)	97 (100.0)

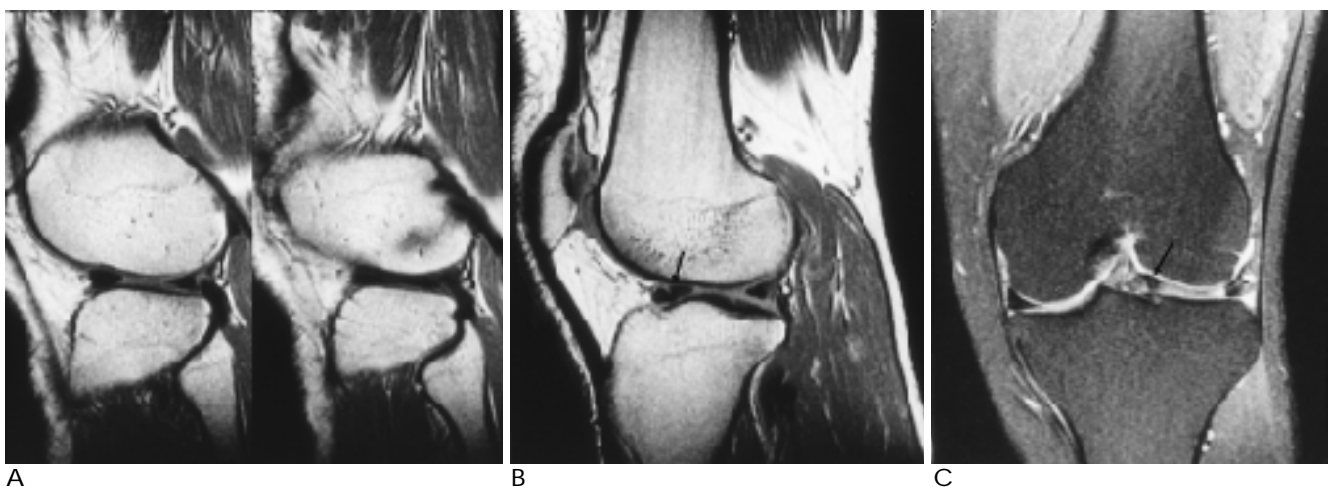


Fig. 1. 36-year-old man with lateral meniscus bucket-handle tear.

A. Only one sagittal image shows bow-tie shaped body of the lateral meniscus.

B. More medial sagittal PD (proton density) weighted image reveals the flipped meniscus sign (arrow).

C. The coronal T2-weighted image well reveals the displaced fragment (arrow).

Table 6, 7 . 8mm 56.4% (122/256), 27.1% (134/ 495) (4- 7). (8), 9 8mm (1,2,9-11) 5mm 가 (Fig. 11.6 mm (9-12 mm) 5,6). (2,3),

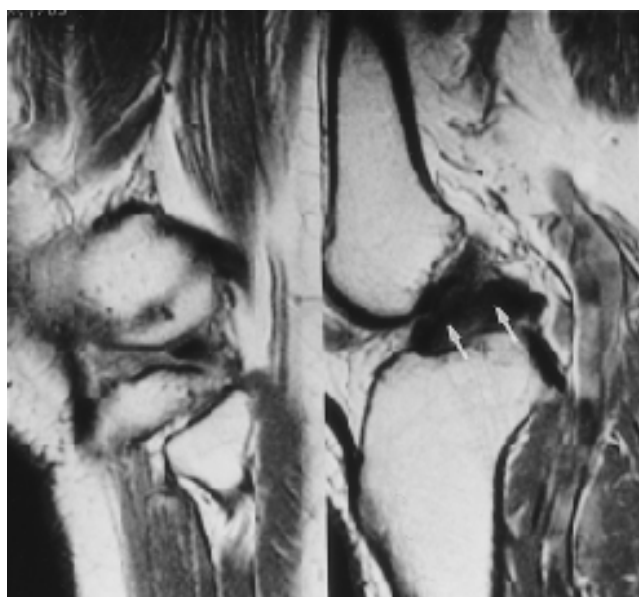


Fig. 2. 27-year-old man with lateral meniscus bucket handle tear. The sagittal PD-weighted images do not show normal body segment leading to the interpretation as positive 'absent bow-tie sign'. Note the inward displaced fragment (white arrows).

Table 4. Number of Sagittal Images with Bow-Tie Appearance (#BT) vs Body Width(BW) in the Group of Bucket-Handle Meniscal Tear

BW(mm)\#BT	0	1	2	sum(%)
1,2	17			17 (39.5)
3,4	12	6		18 (41.9)
5	1	4		5 (11.6)
6		2		2 (4.7)
7				
8			1	1 (2.3)
sum(%)	30 (69.8)	12 (27.9)	1 (2.3)	43 (100.0)

Table 5. Number of Sagittal Images with Bow-Tie Appearance (#BT) vs Body Width(BW) in the Group of Non-Bucket-Handle Meniscal Tear

BW(mm)\#BT	0	1	2	sum(%)
1,2	13	1		14 (13.0)
3,4	13	4		17 (15.7)
5	1	4		5 (4.6)
6		4		4 (3.7)
7		9		9 (8.3)
8	1	14	5	20 (18.5)
9		3	1	4 (3.7)
10	3	4	17	24 (22.2)
11	1	1	2	4 (3.7)
12	2		2	4 (3.7)
13		1	1	2 (1.9)
14			1	1 (0.9)
sum(%)	34 (31.5)	45 (41.7)	29 (26.8)	108 (100.0)

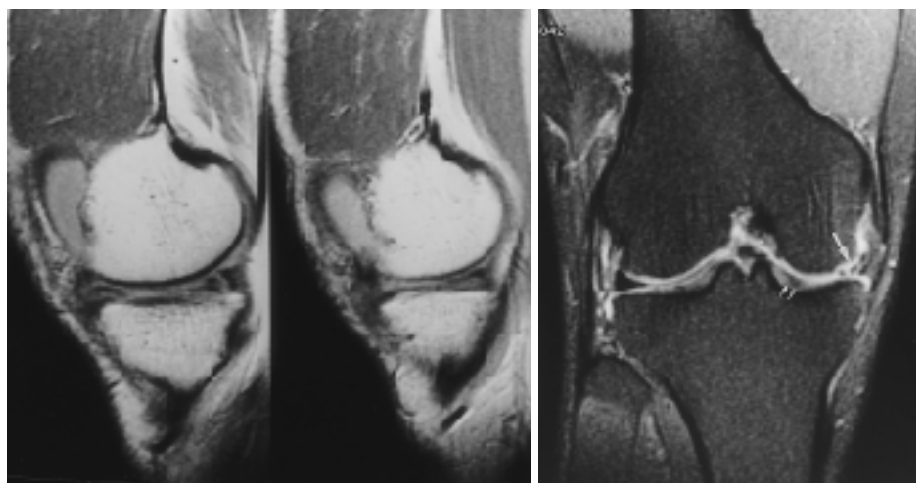


Fig. 3. 42-year-old man with medial meniscus peripheral tear.

A. The serial medial sagittal PD-weighted images do not show normal body segment, suggesting positive 'absent bow-tie sign'.

B. Coronal T2-weighted image reveals tear of the medial meniscus (arrow) which was confirmed peripheral tear on arthroscopy. The fragment-like hypointensity (small arrows) is a inner part of the posterior horn.

A

B

가
3, 4 5mm 가 (1).
3 가
가
volume averag- 97.7%
ing 3 가 (1).
가 (2,12). 73.2%
가

Table 6. Meniscal Body Width(BW) according to the Different Age Bracket in Female Non-Tear Group

BW(mm)\Age	- 10	- 20	- 30	- 40	- 50	- 60	over 60	Sum(%)
5		1	4	2				7 (3.2)
6		4	7	2	1	2	2	18 (8.3)
7		8	15	5	11	5	4	48 (22.2)
8		2	18	8	12	3	6	49 (22.7)
9			11	13	10	7		41 (19.0)
10		2	12	6	11	7	3	41 (19.0)
11				1	3	2	1	7 (3.2)
12			3		1			4 (1.9)
13				1				1 (0.5)
Sum(%)		17 (7.9)	70 (32.4)	38 (17.6)	49 (22.7)	26 (12.0)	16 (7.4)	216 (100.0)

Table 7. Meniscal Body Width(BW) according to the Different Age Bracket in Male Non-Tear Group

BW(mm)\Age	- 10	- 20	- 30	- 40	- 50	- 60	over 60	Sum(%)
5			1					1 (0.2)
6			1	1			1	3 (0.6)
7		6	14	7	3	4		34 (6.9)
8	1	10	45	18	15	4	3	96 (19.4)
9		18	42	29	21	3	1	114 (23.0)
10		26	60	41	21	10	2	160 (32.3)
11		3	15	17	12	2	1	50 (10.1)
12			20	8	4			32 (6.5)
13			2	1	1		1	5 (1.0)
Sum(%)	1(0.2)	63(12.7)	200(40.4)	122(24.7)	77(15.6)	24(4.8)	8(1.6)	495 (100.0)

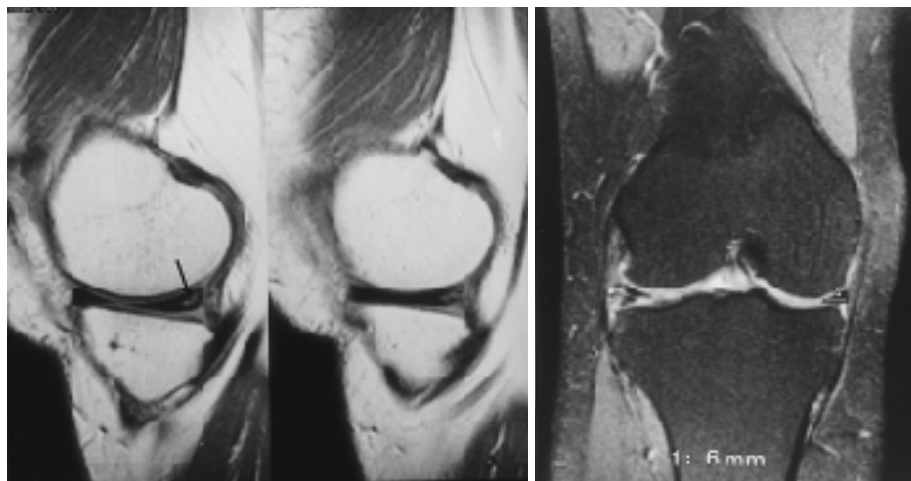


Fig. 4. 51-year-old woman with medial meniscus degeneration.
A. The serial sagittal PD-weighted images reveal meniscal degeneration (arrow) and positive 'absent bow-tie sign'.
B. The width of the medial meniscal body is measured to 6mm on coronal image.

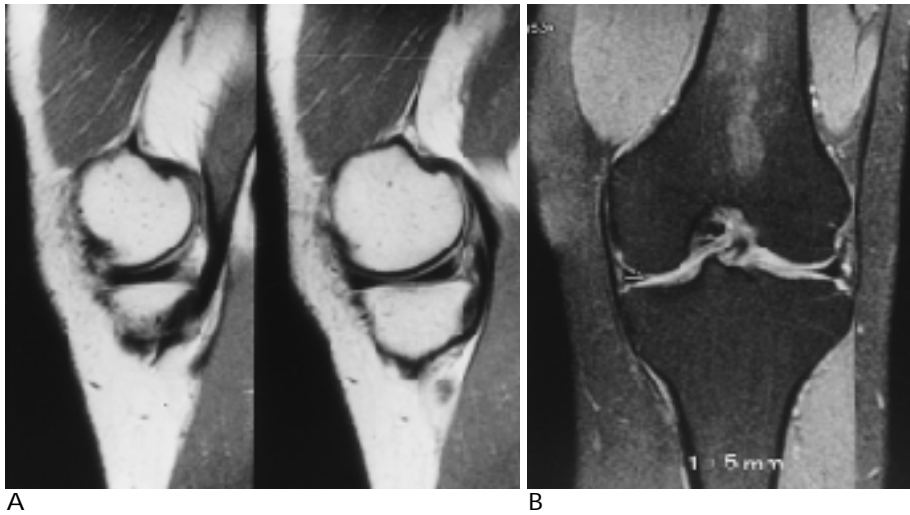


Fig. 5. 23-year-old woman with normal meniscus.

A. The bow-tie shaped body segment of the medial meniscus is only shown on one sagittal slice.

B. The width of this normal medial meniscal body is 5mm according to the measurement on the midcoronal image.

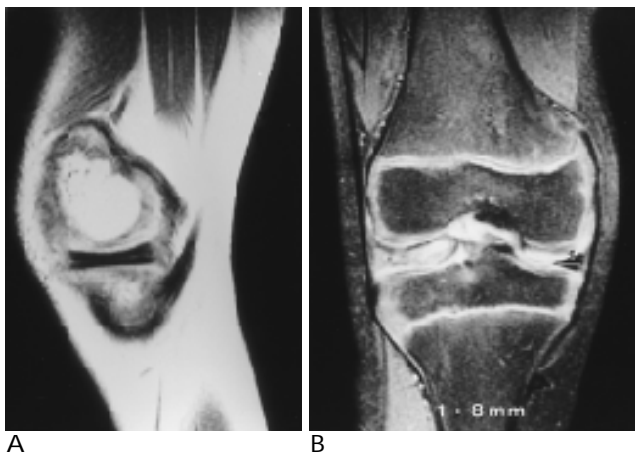


Fig. 6. Nine-year-old boy with normal medial meniscus and torn discoid lateral meniscus.

A. The sagittal PD-weighted image of the medial meniscus shows normal bow-tie body segment.

B. The body width of the medial meniscus is indicated as 8mm on coronal T2-weighted image and the lateral discoid meniscus is torn.

, Magee (8)

35.0%, 27.5%

가

가

5mm 13mm

8mm

(57.4%)

495

가

144

216

(27.1%)

122

1. Helms CA, Laorr A, Cannon WD Jr. The absent bow tie sign in bucket-handle tears of the menisci in the knee. *AJR* 1998;170:57-61
2. Silverman JM, Mink JH, Deutsch AL. Discoid menisci of the knee: MR imaging appearance. *Radiology* 1989;173:351-354
3. Ferrer-Rosa O, Vilalta C. Lesions of the meniscus. I. Macroscopic and histologic findings. *Clin Orthop* 1980;146:289-300
4. De Smet AA, Tuito MJ, Norris MA, Swan JS. MR diagnosis of meniscal tears: analysis of causes of errors. *AJR* 1994;163:1419-1423
5. Fischer SP, Fox JM, DelPizzo W, Friedman MJ, Snyder SJ, Ferkel RD. Accuracy of diagnosis from magnetic resonance imaging of the knee: a multicenter analysis of one thousand and fourteen patients. *J Bone Joint Surg Am* 1991;73-A:2-10
6. De Smet AA, Graf B. Meniscal tears missed on MR imaging: relationship to meniscal tear patterns and anterior cruciate ligament tears. *AJR* 1994;162:905-911

7. Ruff C, Weingardt JP, Russ PD, Kilcoyne RF. MR imaging patterns of displaced meniscus injuries of the knee. *AJR* 1998;170:63-67
8. Magee TH, Hinson GW. MRI of meniscal bucket-handle tears. *Skeletal Radiol* 1998;27:495-499
9. Wright DH, De Smet AA, Norris M. Bucket-handle tears of the medial and lateral menisci of the knee: value of MR imaging in detecting displaced fragments. *AJR* 1995;165:621-625
10. Weiss KL, Morehouse HT, Lery IM. Sagittal MR images of the knee: a low-signal band parallel to the posterior cruciate ligament caused by a displaced bucket-handle tear. *AJR* 1991;156:117-119
11. Haramati N, Staron RB, Rubin S, Shreck EH, Feldman F, Kieman H. The flipped meniscus sign. *Skeletal Radiol* 1993;22:273-277
12. Dalinka MK, Lally JF, Gohel VK. Arthrography of the lateral meniscus. *AJR* 1974;121:79-85

J Korean Radiol Soc 2000;42:181-186

Absent Bow-Tie Sign in Knee MRI

Young-uk Lee, M.D., Jun Yong Park, M.D., Eun Chul Chung, M.D., Eun Kyung Youn, M.D.,
Chang Seok Lee, M.D., Joon Ha Ji, M.D., Kwang Chul Lee, M.D.

¹Department of Radiology, Kangbuk Samsung Hospital, Sungkyunkwan University School of Medicine

Purpose : 'Absent bow-tie sign' is interpreted as positive when a bow-tie-shaped body segment is seen on only one or no slice of 4- or 5-mm thick sagittal images, and is a well known as a useful sign in diagnosing bucket-handle meniscal tears. In practice, however, we have found that this sign was also positive in certain cases other than bucket-handle tears. We have assumed that if the normal range of meniscal body width, as determined among Westerners, is transferred to the Korean population without verification and modification this might lead to misdiagnosis. The purpose of this study, therefore, is to examine the reliability of the 'absent bow-tie sign'.

Materials and Methods : Among 454 cases in which knee MRI had been performed, we retrospectively evaluated 862 menisci, the total remaining after cases of discoid meniscus or those involving previous meniscectomy had been excluded. Among the 862 menisci, 614 were normal, 97 showed degeneration, 43 showed bucket-handle tearing, and 108 showed tears other than bucket-handle tear. In all cases, proton-density and T2-weighted images were obtained in both sagittal and coronal planes, with 3mm section thickness and 1mm gap. We recorded the number of sagittal images in which the body segment of each meniscus had a bow-tie appearance, and measured the width of each meniscal body, as seen on midcoronal images.

Results : In all cases but one of bucket-handle tears (97.7%), the bow-tie sign was absent, as it was in 73.2% of non-bucket-handle tears, 35.0% of degenerated menisci and 27.5% of normal menisci. Among the non-tear group, 56.4% of menisci in the female group and 27.1% in the male group had bodies less than 9 mm wide.

Conclusion : In the diagnosis of bucket-handle tears, the 'absent bow-tie sign' is a very sensitive indicator. It is nonspecific, however, and merely suggests some significant deficiency in the meniscus body or small menisci, so can be positive in other cases. Thus the interpreter should be aware of the characteristics of this sign especially when used to interpret MRI of the knee of a female Korean patient.

Index words : Knee, MR

Knee, ligaments, menisci, and cartilage

Address reprint requests to : Young-uk Lee, M.D., Department of Radiology, Kangbuk Samsung Hospital, Sungkyunkwan University School of Medicine, 108 Pyeong-dong, Chongro-gu, Seoul 100-638, Korea.
Tel. 82-2-2001-2342 Fax. 82-2-2001-2797 E-mail. youngleee@nuri.net