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·  
1

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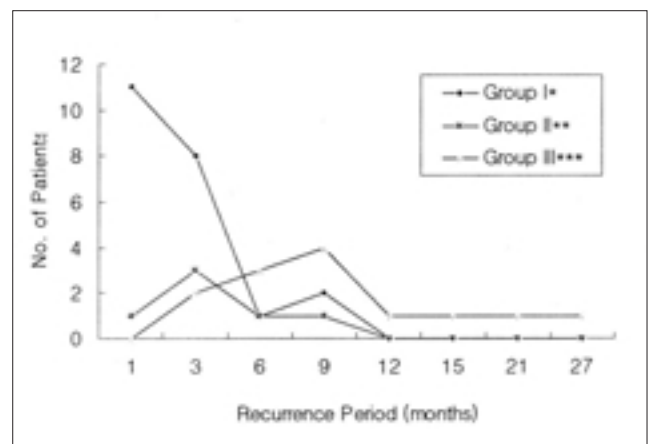
:

·  
: 2000 1 2001 12  
가 5 cm 가 2 cm CT  
37 (41 )  
·  
I , 가 1 cm II , 1 - 2 cm III  
· 41 I 22 , II 6 , III 13  
3.2 cm , I 3.3 cm, II 2.9 cm, III 3.1 cm  
· CT , T -  
test  
·  
: 5.5 , I 2.7 , II 3.0 ,  
III 10.5 . T - test I III 가  
( $p < 0.0001$ ), I II , II III 가 1  
cm I II III 가  
( $p < 0.0001$ ).  
:  
1 cm 가 1 cm  
·

(Radiofrequency Thermal Ablation) (subcapsular) (safety margin)  
가 가 가 , (central)  
(1, 2). 가 460 kHz (heat - sink effect)  
가 (complete ablation) 가 (7,  
(agitation) 가 8). (mid -  
zone) (7 - 10).  
·  
(3). 가 ,  
18 - 38% (1, 4), 가 ,  
가 , 가 90% .  
(5 - 7). 3 cm (8).

가 5 cm  
가 2 cm  
CT 37 (41 )  
CT AFP  
( > 100 ng/mL ) , 1  
36 - 75  
58 , 29 , 8  
38 CT , 3  
MRI  
가 가  
가  
가 1 cm II , 1 -  
2 cm III CT  
I  
41 I 22 , II 6 , III 13  
3.2 cm , I 3.3 cm,  
II 2.9 cm, III 3.1 cm  
CT  
10 , 9 I 1 III  
I 9 4  
CT  
Keiran (Ketamine HCl,  
, ) 10 mg, Pofol (propofol,  
, ) 30 mg, Demerol (pethidine HCl,  
, ) 25 mg  
0.5 mg/kg Pofol Demerol 25 mg  
RITA Medical system, Inc.(Mountain  
View, CA, U.S.A.) 50  
(480 kHz)  
15 gauge  
4 7  
가 100 10 1  
가  
가  
1 CT  
CT Somatom Plus  
40 (Siemens, Erlangen, Germany) , 300 mg/mL  
(Ultravist 300 ; Schering AG, Berlin,  
Germany) 120 mL 3 mL/sec 30  
60 120  
kVp, 220 mAs, 7 mm, 7 mm, pitch  
1.2 CT

가  
(complete  
CT  
CT  
ablation)  
1, 3  
3  
(peritumoral hyperemia)  
가  
가  
가  
CT  
, T - test  
5.5 , I  
(Fig. 1).  
가 11  
2.7 , II 3.0 , III 10.5  
I 1 CT  
(50.0%) 가 (Fig. 2), 19 (86.4%)가 3  
가  
II 6 1 (1 ) , 3 (3  
) (Fig. 3), 6 (1 ) , 9 (1 )  
I 가 III  
I II 3  
27  
1 12 (29.3%) II 1  
(8.3%) 11 (91.7%)가 I  
T -  
test I III 가  
( $p < 0.0001$ ), I II , II III 가  
1 cm I  
II III  
가 ( $p < 0.0001$ ).



**Fig. 1.** Period of marginal recurrence according to distance from tumor to hepatic capsule.

\*: stick to hepatic capsule ( $n = 22$ ), \*\*: less than 1 cm ( $n = 6$ ), \*\*\*: from 1 to 2 cm ( $n = 13$ )

I 16 (72.7%) , 4  
(18.2%) , 2  
(9.1%) 가 가 . II  
가 4  
(66.7%) 2 (33.3%) . III 5 (38.5%)가  
, 4 (30.8%)  
, 4 (30.8%) . I  
II III  
Fisher's exact test  
( $p=0.084$ ) (Table 1).

(11).

(percutaneous ethanol injection),  
(microwave coagulation), (inter -

stitial laser photocoagulation), (cryosurgery)  
(1, 2, 12 - 14).

가 5 cm 가 4  
(9).

, 가  
가 (6, 15).

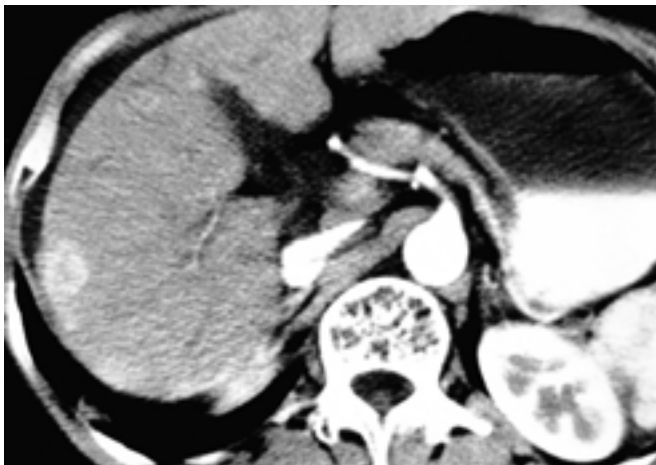
가 0.5 - 1 cm (

)  
가  
(16).

가 (17). (10 - 20%)  
360 ° 1 cm  
2 cm가

, 가 가  
(16, 18).

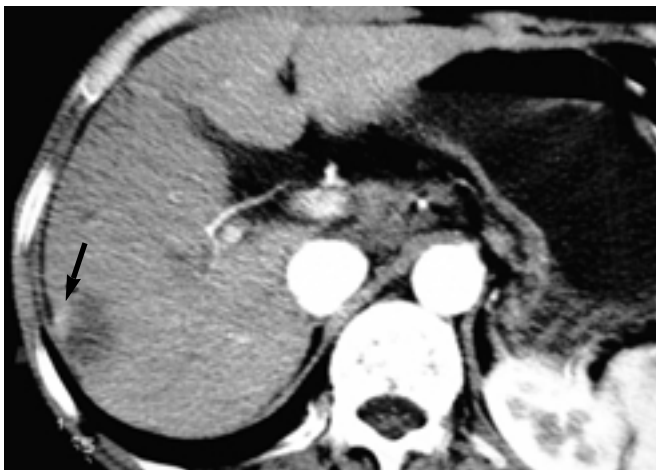
가가



A



B



C

**Fig. 2.** A patient in Group I with marginal recurrence on one-month follow-up CT.

**A.** Pretreatment CT scan depicts a 2 cm-diameter hepatocellular carcinoma stuck to hepatic capsule.

**B.** Immediate CT scan after RF ablation shows hypoattenuated ablated region covering the tumor extent.

**C.** One-month follow-up CT shows small nodular enhancement (arrow) at the capsular side of tumor margin.

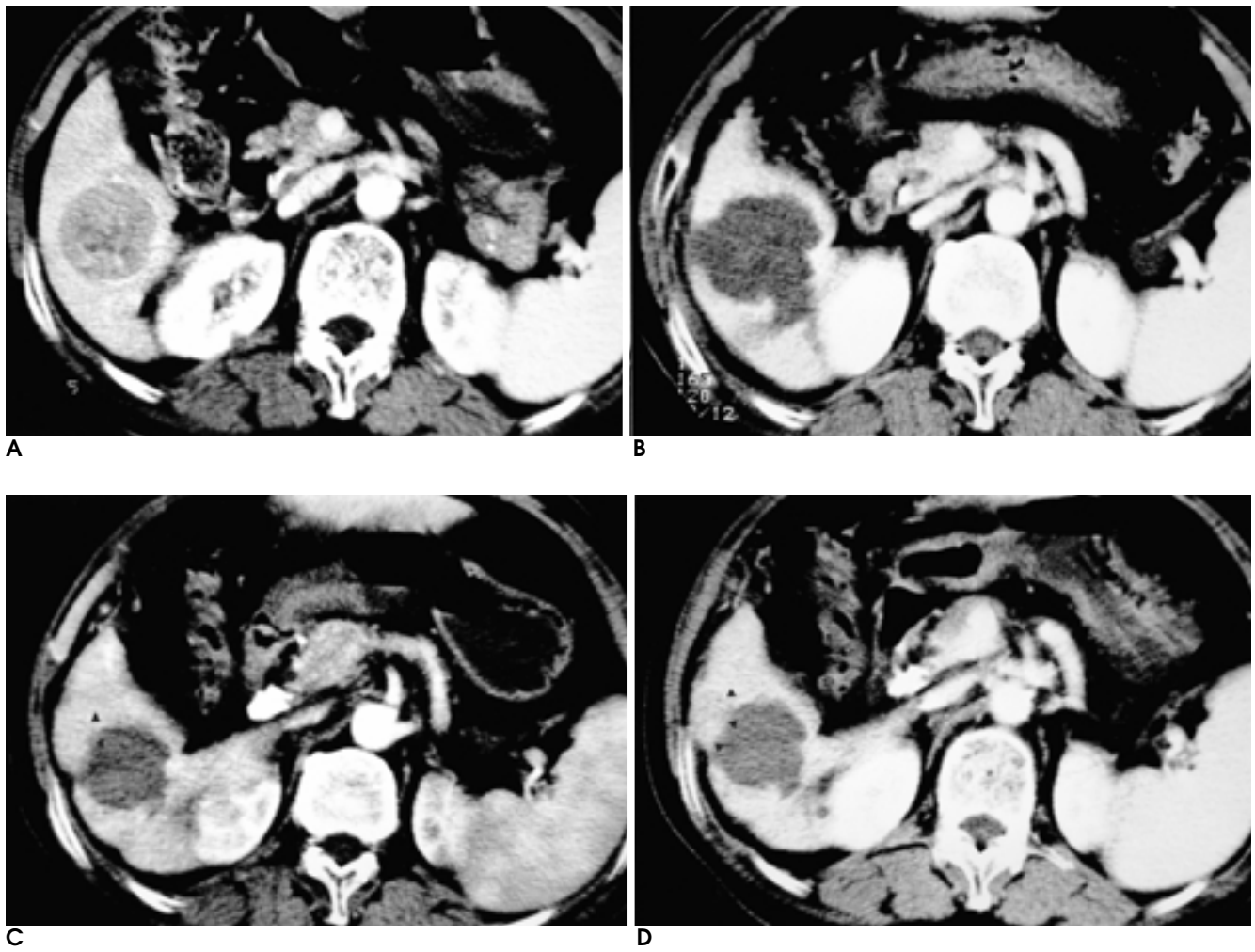
(19-21).  
가 1 cm  
(9, 16).  
( , 가 )  
가  
CT 가  
가  
MR,  
가 (22 - 25).

CT가 가 가  
, Solbiati (23) CT  
CT 가 14 CT  
가 2 (14%)  
CT

**Table 1.** Site of Marginal Recurrence According to Distance from Hepatic Capsule to Tumor

Site of recurrence	Group I (n=22)*	Group II (n=6)**	Group III (n=13)***
Capsular side(%)	16 (72.7)	4 (66.7)	5 (38.5)
Non-capsular side(%)	4 (18.2)	2 (33.3)	4 (30.8)
Both sides(%)	2 ( 9.1)	0 (0)	4 (30.8)

\*: HCC stuck to hepatic capsule  
\*\*: HCC located less than 1cm-distance from hepatic capsule  
\*\*\*: HCC located from 1 to 2 cm-distance from hepatic capsule



**Fig. 3.** A patient in Group II with marginal recurrence on three-month follow-up CT.  
**A.** Pretreatment CT scan depicts a 4 cm-diameter hepatocellular carcinoma at a distance less than 1 cm from hepatic capsule.  
**B.** Immediate CT scan after RF ablation shows hypoattenuated ablated region covering the tumor extent.  
**C, D.** Three-months follow-up CT shows nodular enhancement (arrowheads) on arterial phase (**C**) and hypodense lesion (arrowheads) on portal phase (**D**) at the capsular side of tumor margin.

가 (22).  
 12 CT  
 CT  
 가 1 CT  
 . 91.7% (11/12)가 I  
 가 가  
 가  
 I II III  
 가 가 가  
 가 I II  
 III  
 가 1 cm  
 , 1 cm  
 1 cm 가  
 , 2001  
 (residual)  
 (recurrent)  
 CT 가  
 1 cm 가  
 가  
 가  
 가 2 cm  
 가 1 cm  
 가 1 cm  
 가  
 cm 가 CT 가  
 가

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## Marginal Recurrence after Radiofrequency Ablation of Hepatocellular Carcinoma: Relationship between Distance from Hepatic Capsule to Tumor and Recurrence Period<sup>1</sup>

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**Purpose:** To examine the relationship between distance from hepatic capsule to tumor and recurrence among hepatocellular carcinoma patients in whom marginal recurrence was noted after radiofrequency ablation therapy.

**Materials and Methods:** Between January 2000 and December 2001, hepatocellular carcinoma patients with a tumor 5 cm or less in size and located 2 cm or less from the hepatic capsule underwent radiofrequency ablation therapy. We subsequently selected 37 patients (41 tumors) in whom immediate CT demonstrated complete tumor ablation and follow-up CT showed marginal recurrence. Tumors were grouped according to their distance from the hepatic capsule: Group I, adhered to the capsule; Group II, less than 1 cm from it; Group III, 1-2 cm distant. Of the 41 tumors, 22 were assigned to Group I, six to Group II, and 13 to Group III. Mean tumor size was 3.2 cm, and inter-group variation was small (Group I, 3.3 cm; Group II, 2.9 cm; Group III, 3.1 cm). Follow-up CT was used to determine marginal recurrence, and for inter-group comparison and the assessment of statistical significance, the t test was employed.

**Results:** Marginal recurrence was noted at mean 5.5 months (2.7 months in Group I, 3.0 months in Group II, and 10.5 months in Group III). The t test revealed significant difference between Group I and III ( $p < 0.0001$ ) but not between Groups I and II, or II and III. If '1 cm from hepatic capsule' was the criterion for classification, and Group I and II were combined and compared with Group III, there was significant difference between the two groups ( $p < 0.0001$ ).

**Conclusion:** Tumors which adhered to the hepatic capsule or were less than 1 cm from it recurred sooner than those situated 1 - 2 cm away.

**Index words :** Liver neoplasm, interventional procedure  
Radiofrequency (RF) ablation  
Liver neoplasms, CT

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