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                                                                    .   1)   ,

                ,   , 2)

                                                                    , 3)   DentaScan

                        33   (19,   14)

                                        CT HiSpeed Advantage

        .   V-worksTM 3.0

                3   . DentaScan   3

                        ,   ,

                                        .   22

        (Image-Pro®Plus, Ver. 4.0, Media Cybernetics, U.S.A)

                                                                                                ,

                ,

        21   ,   .

                                                                                                DentaScan

.   .

1.

6   ,   (18   , 54.5%)

(7   , 21.2%)   .   1

(14   , 58.4%),   (8   ,

33.3%)   2   (2   , 8.3%)   .

(31   , 93.9%),   2

(2   , 6.1%).

2. 3   ,

39.3mm (: 40.7mm,   : 37.4mm),   37.1mm (:

39.4mm,   : 34.0mm)   ,   32.6mm (: 35.3mm,

28.9mm)   .

15.1   18.0   ,   11.1   .

3.   1

5.72   , 6.27   ,   2

,   4.82   .   1

,

3.01   , 3.53   , 3.87   ,   2

,

2.82   , 2.74   , 3.40   .

4.   ,

1

,   2

,   1   ,   2

.

5.

, 1

(Type I) 12 (54.5%)

, 2

(Type I) 11

(52.4%) .

6.

3 , 1

(Type 2) 8 (80%) , 2

Type 2 8 (80%) .

7. , DentaScan

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DentaScan .

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DentaScan ,

DentaScan

, DentaScan

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: , , , DentaScan

I.

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.[1,2]

(inferior wall)

.   ,   (medial

wall)   (buccoalveolar wall)   .

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0.5

.   0.5

1,   2   5%, 20%   ,   1,   2

27%, 46%   .[3]

[4]

, Wehrbein

[5]

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,

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(bony partition)

.   1   2

,

[6,7]

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[8]

,   [9]

[10,11,12]

,

[13,14,15,16]

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.

(bony defect)

[17,18,19]
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3　　　　　　　　　　　.

(CT) DentaScan　　 multiplanar reformation (CT/MPR)

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CT　　　　 1980　　　　　　　　[20]

[21,22,23]　　　　　　　　　　 [24]
，　　　　　　　　　　　，

[25,26]

.　　　　　　　　　　　　　　　　　　 CT

[4,12,27,28]　　　　　　　　　 CT
，

[23,29]　　　　　　　　　　　　　　 [29]
，

[30]　　　 [31,32]　　　　　　　　 CT
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DentaScan　　　　　　　　　　　　　　　 .

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，　　　　　 (apical surgery),　　，　　　，

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II.

1.

33　　　（　　　19，　　　14　（　　　　18，　　　15）;　　　　　　55.8　）

(Table 1).

.　　　　　　　　　　　　　　　　　　　　　　　　　15　,

7　,　　　　　　　　　　　　　　　　11　　　.

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wafer　　　　　　　. Wafer

,　　　　　　　　　　　　　　　　　　　　gutta

purcha　　　　　　　　　　　　　　　　　　　　　　.

Table 1. Materials used in this study according to age groups.

Age groups	male	female	total
10　19	4	0	4
20　29	0	0	0
30　39	0	0	0
40　49	4	2	6
50　59	6	3	9
60　69	5	0	5
70　79	0	8	8
80　89	0	1	1
total	19	14	33

2.

　　　 .

　　(1)

　　　　　　　　　　　　　　　　　　(X-70S, Yoshida Co., Tokyo,
Japan) XCP

　　　　　　　　　　　　　　　　　　　　　　　　　.

　　(2)

　　　 ,　　　　　　　　　　　　　　　　　　CT HiSpeed
Advantage　　　　　　　　　(GE Medical System, Milwaukee, U.S.A.)
　　high-resolution bone algorithm, 15 cm field of view (FOV), 200 mA,
120 kV, scanning time 1 ,　　　　5
　　　　　　　　　　　　. Gantry　　　　0　　　　reconstruction
matrix　512x512 pixel　　　.
CT　　　　Advantage Window workstation (GE Medical System, Milwaukee,
U.S.A.)　　　　DentaScan　　　　　　　(GE Medical System,
Milwaukee, U.S.A.)　　　　　　　 ,
(cross-sectional image)　　　. Fuji medical laser imager FL-IM
D (Fuji Photo Film Co., Ltd., Tokyo, Japan)　　　　　　　.
　　　　　　　　　　　　　　　　(pentium III-500,
dual CPU, 512 MRAM)　　　　　　V-works^{TM} 3.0
(CyberMed Inc., Korea)　　　3　　　　(Fig. 1).

　　　　　　　　3

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3 , , ,

V-works^{TM} 3.0 .

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I ,

II ,

III

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IV , 2 1

V ,

VI
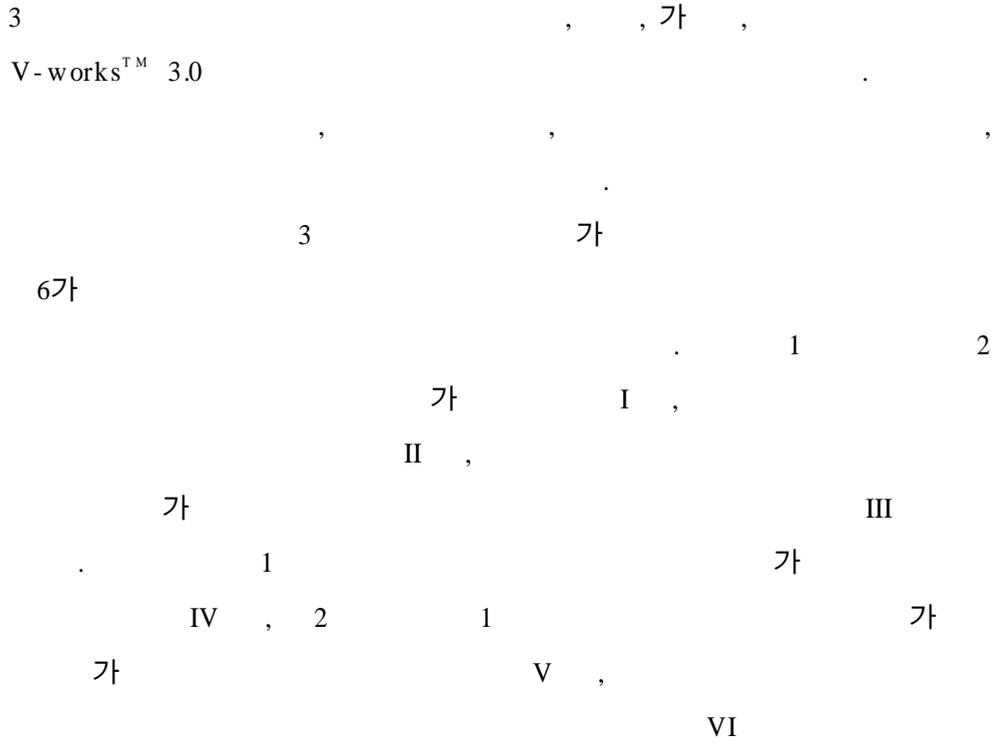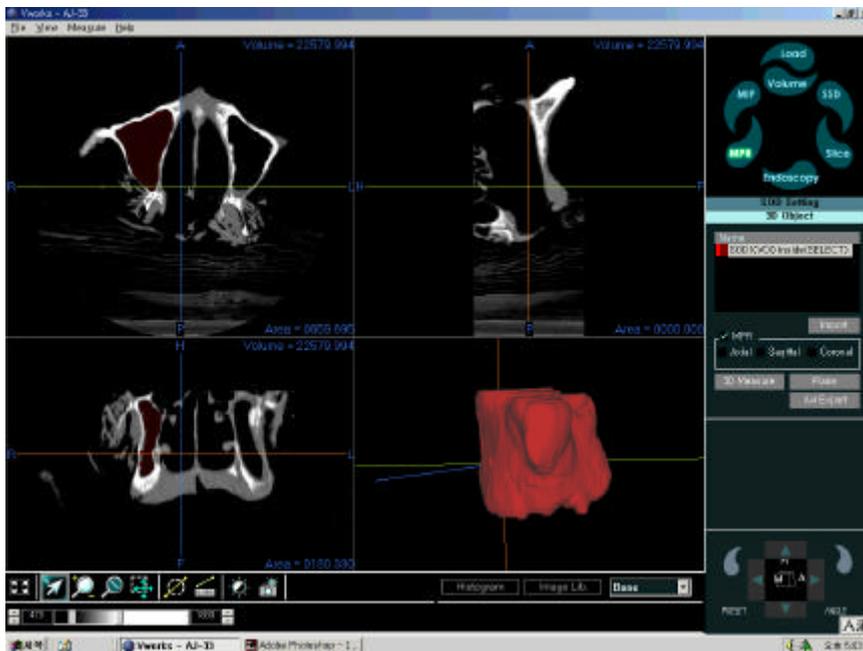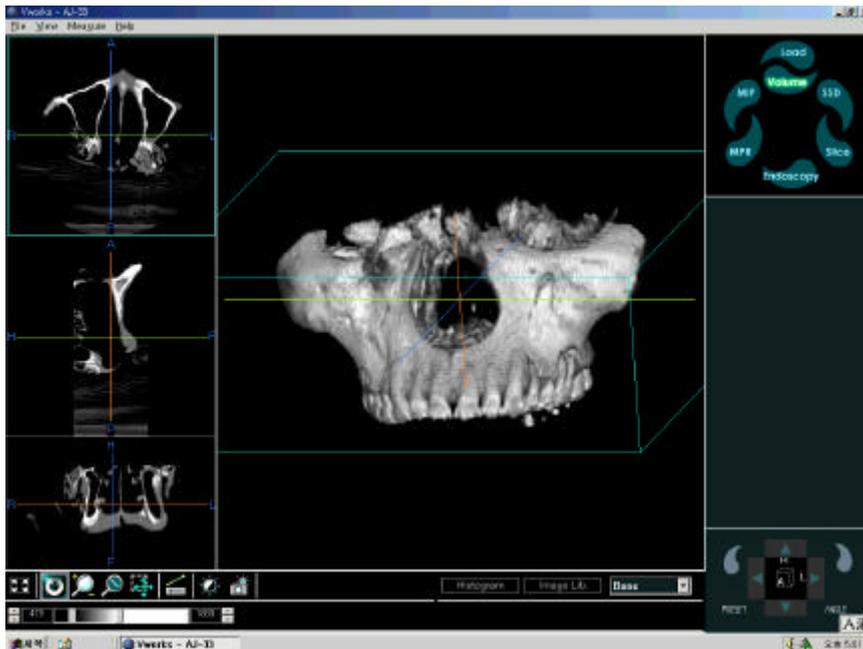
(Fig. 2).

Fig. 1. Captured frame images on the V-works^{TM} 3.0 program.
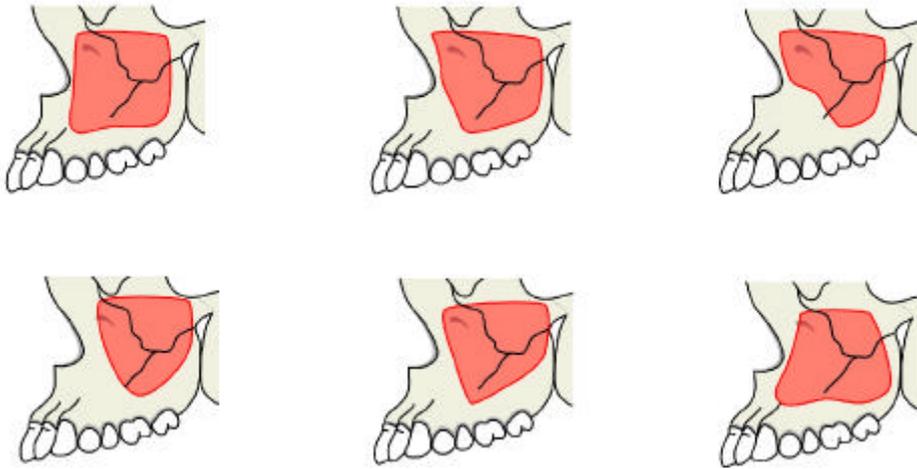
Fig. 2. Schematic illustrations of lateral morphology of the maxillary sinus according to their lateral 3-D reconstructive images.

All illustrations are left sides of the specimens.

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(1)

40

(decalcification solution) 4 7 .

alminium chloride hexahydrate (Al2Cl36H2O) 7g, 30% hydrochloric acid 8.5 , formic acid 5 100 .

, sodium sulfate 5g 100

(neutralization solution) 2 3

DentaScan .

.

(2) (Fig. 3)

1, 2 , 1, 2

(hp ScanJet 6100c, HP Co., USA)

, (Image-Pro$^{®}$Plus, ver. 4.0,

Media Cybernetics, U.S.A) (standard calibration)

, 21 .

(Fig. 3)

1. The maximum width between the buccal and the palatal alveolar plate (width) :

2. Horizontal distance between the midpoint of the palatal root and the palatal alveolar plate (P/mid) :

3. Horizontal distance between the apex of the palatal root and the palatal alveolar plate (P/a-h) :

4. Shortest distance between the apex of the palatal root and the inferior wall of maxillary sinus (P/a-s) :

5. Horizontal distance between the midpoint of the buccal root and

the buccal alveolar plate (B/mid) :

6. Horizontal distance between the apex of the buccal root and the buccal alveolar plate (B/a-h) :

7. Shortest distance between the apex of the buccal root and the inferior wall of maxillary sinus (B/a-s) :

8. Distance between the apex of the palatal and the buccal root (PB/a-a) :

9. Horizontal distance between the midpoint of the mesiobuccal root and the buccal alveolar plate (M/mid) :

10. Horizontal distance between the apex of the mesiobuccal root and the buccal alveolar plate (M/a-h) :

11. Shortest distance between the apex of the mesiobuccal root and the inferior wall of maxillary sinus (M/a-s) :

12. Horizontal distance between the midpoint of the distobuccal root and the buccal alveolar plate (D/mid) :

13. Horizontal distance between the apex of the distobuccal root and the buccal alveolar plate (D/a-h) :

14. Shortest distance between the apex of the distobuccal root and the inferior wall of maxillary sinus (D/a-s) :

15. Distance between the apex of the palatal and the mesiobuccal root (PM/a-a) :

16. Distance between the apex of the palatal and the distobuccal root (PD/a-a) :

17. Cortical thickness of the inferior wall of maxillary sinus to the nearest of the apex of the palatal root (P/b) :

18. Cortical thickness of the inferior wall of maxillary sinus to the nearest of the apex of the buccal root (B/b) :

19. Cortical thickness of the inferior wall of maxillary sinus to the nearest of the apex of the mesiobuccal root (M/b) :

20. Cortical thickness of the inferior wall of maxillary sinus to the nearest of the apex of the distobuccal root (D/b) :

21. Cortical thickness of the inferior wall of maxillary sinus to the nearest of the furcation area (F/b) :

Fig. 3. Illustrations showing parameter #1　#21 measured on the sectioned specimen (B : buccal, P : palatal).
For definitions, see Materials and Methods.

(3) DentaScan

(Fig. 4, 5)

DentaScan

7

5   (Fig. 4).

Fig. 4. **Schematic illustrations of 5 classifications of vertical relationship between the inferior wall of maxillary sinus and the roots of the maxillary molars (B : buccal, P : palatal).**

Type I :

.

Type II :

. ,

Type III :

Type IV :

Type V :

3   (Fig. 5).

Fig. 5. Schematic illustrations of 3 classifications of horizontal relationship between the inferior wall of maxillary sinus and the roots of the maxillary molars (B : buccal, P : palatal).

Type 1 :

Type 2 :

Type 3 :

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(1)

DentaScan

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(2) DentaScan

DentaScan

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DentaScan

(furcation area)

(furcation involvement),

(apical

involvement),

(apical lesion) 0 ( ), 1 ( )

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DentaScan

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), (

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DentaScan   ,

                                                                             .

                                                      .

III.

1. V-works TM 3.0

3

6   (Fig. 2, 6).   33   3

1   2

I   8   (24.2%)   ,

II   7   (21.2%),

III   5   (15.2%)   .   1

IV   7

(21.2%),   2   1

V   3   (9.1%),

VI   3   (9.1%)   (Table 2).

Table 2. Classifications of the 3-dimensional morphology of the maxillary sinus according to their lateral aspects and the inferior walls.

Types	male (n=19)	females (n=14)	total (%)
I	5	3	8 (24.2%)
II	4	3	7 (21.2%)
III	2	3	5 (15.2%)
IV	3	4	7 (21.2%)
V	2	1	3 (9.1%)
VI	3	0	3 (9.1%)

Numerical is the number of samples observed.

Type I   Type II   Type III

Type IV   Type V   Type VI
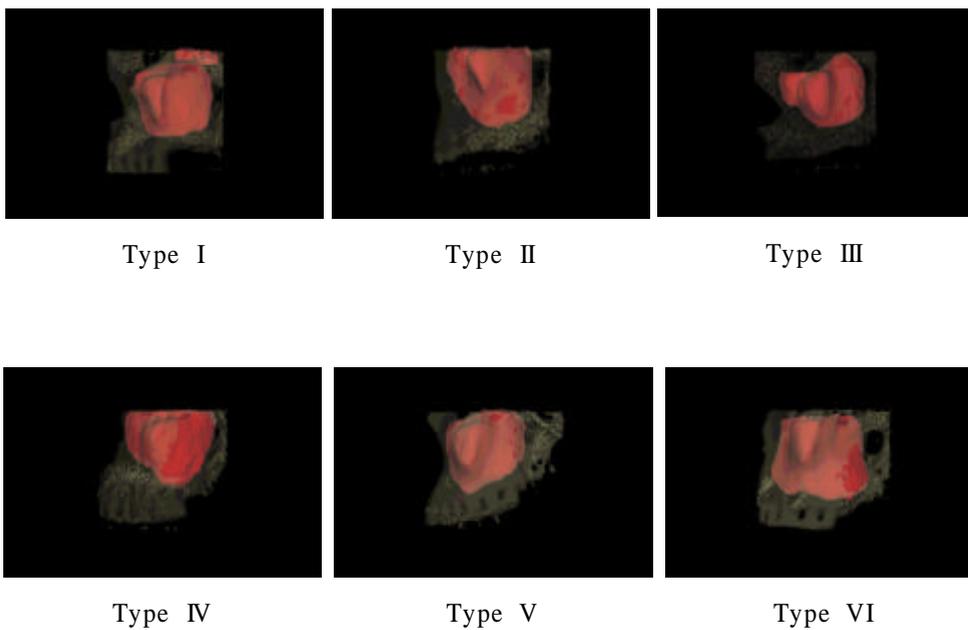
Fig. 6. Photographs showing the lateral views of the 3-D reconstructed maxilla and maxillary sinus on the V-works^{TM} 3.0 program.

3   ,

39.3 (: 40.7 ,   : 37.4),   37.1   (:
39.4 ,   : 34.0)   32.6   (: 35.3 ,
28.9)   .

15.1   18.0 ,   11.1   (Table 3).

Table 3. Measurements of the maxillary sinus using the 3-dimensional reconstructive images using the V-works program.

	male (n=19)	female (n=14)	total (n=33)
maximum A-P length (mm)	40.7 ± 4.5	37.4 ± 3.0	39.3 ± 4.2
maximum height (mm)	39.4 ± 5.8	34.0 ± 3.5	37.1 ± 5.6
maximum width (mm)	35.3 ± 6.9	28.9 ± 3.5	32.6 ± 6.5
volume (ml)	18.0 ± 6.2	11.1 ± 3.4	15.1 ± 6.2

unit : mean± S.D.

2. DentaScan   (Fig. 7)

　　　33   DentaScan

                                                    24

DentaScan   ,

                           .

                      1

(14   , 58.4%),   (8   , 33.3%)

      2   (2   , 8.3%)   .

(31   , 93.9%),   2

            (2   , 6.1%).

1   (8)   2

(6)   ,

2   (4),   (4),   2   1

(2),   1   2   (2),   1

(2),   2   2   (1)

.

7

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Fig. 7. DentaScan Image showing the reformatted panoramic view of the maxilla and maxillary sinus.

3.

Table 4   .

(#1 : width)   2   (15.19),

1   (11.15   ).

                                                            (#6, 10, 13)

2   (:   5.48   ,

                  :   4.48   ),   1   (

1.99   ).

              1   ,

                              (#7, 4)   5.72   (0   10.24),

6.27   (0   14.44)   ,

                              (#18, 17)   0.44   (0

0.68), 0.50   (0   0.78)   .

              2   (#4)

    4.82   (0   13.54)   ,

        (#18)   0.55   (0   1.17)   .   1

              ,

                              (#11, 14, 4)   3.01   (0

11.14), 3.53   (0   9.45), 3.87   (0   9.37)   ,

                              (#19, 20, 17)   0.42   (0

0.91,   ), 0.53   (0   1.25,

    ), 0.51   (0   1.31,   )   .

              2   ,

                              (#11, 14, 4)

    2.82   (0   10.84), 2.74   (0   11.00), 3.40   (0

    9.85)   ,   (#19, 20, 17)

0.40   (0   0.89,   ), 0.37   (0

0.98,   ), 0.46   (0   0.74,

)   .

Table 4. Measurements between the maxillary posterior teeth and adjacent anatomical structures.

	width	P/mid	P/a-h	P/a-s	B/mid	B/a-h	B/a-s	PB/a-a	P/b	B/b	F/b
No. of items	1	2	3	4	5	6	7	8	17	18	21
Maxillary 1st premolar											
n	18	21	21	10	21	21	3	12	8	3	3
mean	11.15	3.79	8.54	6.27	1.28	1.99	5.72	3.57	0.50	0.44	0.52
SD	1.52	1.06	1.96	5.16	0.91	1.10	5.22	1.66	0.26	0.38	0.47
Max	13.93	5.71	12.14	14.44	3.51	4.45	10.24	6.74	0.78	0.68	0.90
Min	8.51	2.49	5.58	0.00	0.00	0.42	0.00	1.34	0.00	0.00	0.00
Maxillary 2nd premolar											
n	19	20	19	18	18	20	3	3	18	3	3
mean	11.06	3.80	9.81	4.82	2.08	3.50	4.37	3.14	0.55	0.76	0.77
SD	1.87	1.82	2.81	4.25	0.83	1.39	3.43	1.65	0.31	0.28	0.33
Max	13.74	9.18	15.21	13.54	3.43	5.76	7.65	4.70	1.17	1.01	1.13
Min	7.63	1.46	3.91	0.00	0.63	1.64	0.82	1.41	0.00	0.46	0.50

n : numbers of the samples, SD : standard deviation, Max : Maximum, Min : Minimum

Table 4. (continued)

	width	P/mid	P/a-h	P/a-s	M/mid	M/a-h	M/a-s	D/mid	D/a-h	D/a-s	PM/a-a	PD/a-a	P/b	M/b	D/b	F/b
No. of Items	1	2	3	4	9	10	11	12	13	14	15	16	17	19	20	21
Maxillary 1st molar																
n	19	22	22	22	15	17	18	18	19	19	12	19	21	18	19	22
mean	14.81	2.52	5.27	3.87	1.82	3.39	3.01	1.80	3.30	3.53	9.04	8.81	0.51	0.42	0.53	0.61
SD	1.52	1.07	1.90	2.91	0.96	1.50	2.82	0.85	1.82	2.88	1.14	1.76	0.31	0.28	0.36	0.24
Max.	17.01	4.40	9.57	9.37	3.84	6.93	11.14	2.92	8.12	9.45	11.09	11.57	1.31	0.91	1.25	1.35
Min.	12.47	0.90	2.75	0.00	0.39	0.86	0.00	0.23	0.71	0.00	6.99	4.07	0.00	0.00	0.00	0.26
Maxillary 2nd molar																
n	17	21	21	21	15	16	17	15	16	17	13	16	21	17	17	21
mean	15.19	2.56	4.44	3.40	3.01	5.48	2.82	2.76	4.48	2.74	5.36	6.40	0.46	0.40	0.37	0.58
SD	1.54	0.77	1.64	3.06	1.07	1.66	3.08	0.78	1.29	3.23	2.11	2.43	0.20	0.25	0.29	0.16
Max.	17.35	4.25	8.69	9.85	4.73	7.76	10.84	4.64	7.26	11.00	9.23	9.79	0.74	0.89	0.98	0.93
Min.	11.40	1.20	1.70	0.00	1.00	1.24	0.00	1.69	2.58	0.00	2.70	3.37	0.00	0.00	0.00	0.34

n : numbers of the samples, SD : standard deviation, Max : Maximum, Min : Minimum

1. width : The maximum width between the buccal and the palatal alveolar plate

2. P/mid : Horizontal distance between the midpoint of the palatal root and the palatal alveolar plate

3. P/a-h : Horizontal distance between the apex of the palatal root and the palatal alveolar plate

4. P/a-s : Shortest distance between the apex of the palatal root and the inferior wall of maxillary sinus

5. B/mid : Horizontal distance between the midpoint of the buccal root and the buccal alveolar plate

6. B/a-h : Horizontal distance between the apex of the buccal root and the buccal alveolar plate

7. B/a-s : Shortest distance between the apex of the buccal root and the inferior wall of maxillary sinus

8. PB/a-a : Distance between the apex of the palatal and the buccal root

9. M/mid : Horizontal distance between the midpoint of the mesiobuccal root and the buccal alveolar plate

10. M/a-h : Horizontal distance between the apex of the mesiobuccal root and the buccal alveolar plate

11. M/a-s : Shortest distance between the apex of the mesiobuccal root and the inferior wall of maxillary sinus

12. D/mid : Horizontal distance between the midpoint of the distobuccal root and the buccal alveolar plate

13. D/a-h : Horizontal distance between the apex of the distobuccal root and the buccal alveolar plate

14. D/a-s : Shortest distance between the apex of the distobuccal root and the inferior wall of maxillary sinus

15. PM/a-a : Distance between the apex of the palatal and the mesiobuccal root

16. PD/a-a : Distance between the apex of the palatal and the distobuccal root

17. P/b : Cortical thickness of the inferior wall of maxillary sinus to the nearest of the apex of the palatal root

18. B/b : Cortical thickness of the inferior wall of maxillary sinus to the nearest of the apex of the buccal root

19. M/b : Cortical thickness of the inferior wall of maxillary sinus to the nearest of the apex of the mesiobuccal root

20. D/b : Cortical thickness of the inferior wall of maxillary sinus to the nearest of the apex of the distobuccal root

21. F/b : Cortical thickness of the inferior wall of maxillary sinus to the nearest of the furcation area

4.

(Fig. 4, 5, 8, 9)

, 22   1

(Type I)

12   (54.5%)   ,

(Type II)   4   (18.3%)   .

(Type III)

(Type IV),

(Type V)   1   (4.5%), 3   (13.6%), 2   (9.1%)

. 21   2

(Type I)   11   (52.4%)

,

(Type II)   6   (28.6%)   (Table 5).

Table 5. Incidences and classifications of vertical relationship between the inferior wall of maxillary sinus and the roots of the maxillary molars.

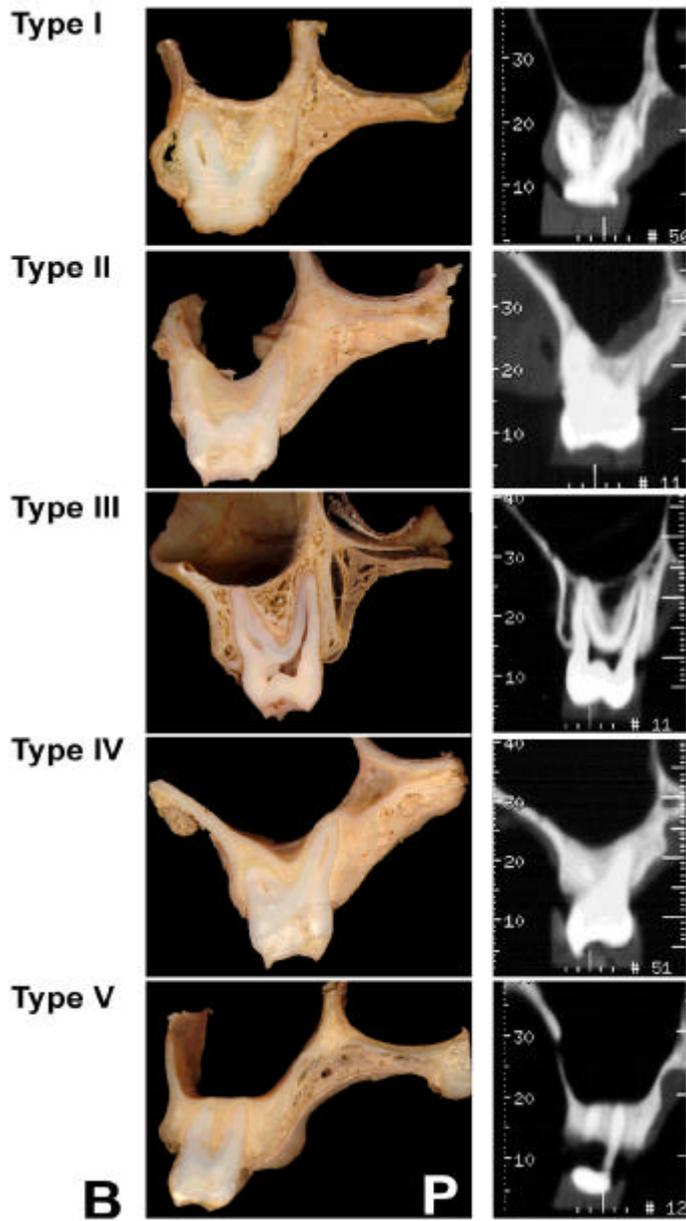| Classifications	Maxillary 1st molar	Maxillary 2nd molar
I	12 (54.5%)	11 (52.4%)
II	4 (18.3%)	6 (28.6%)
III	1 (4.5%)	3 (14.2%)
IV	3 (13.6%)	0 (0%)
V	2 (9.1%)	1 (4.8%)

Numerical is the number of samples observed.

Fig. 8. Classifications of vertical relationship between the inferior
wall of maxillary sinus and the roots of the maxillary molars
(B : buccal, P : palatal).

3   .

                                                                      10

        1

                                              (Type 2)   8   (80%)

              .   10   2

        ,   (Type

2)   8   (80%)   .   1,   2

              (Type 3)   (Table 6).

Table 6. Incidences and classifications of horizontal relationship between the inferior wall of maxillary sinus and the roots of the maxillary molars.

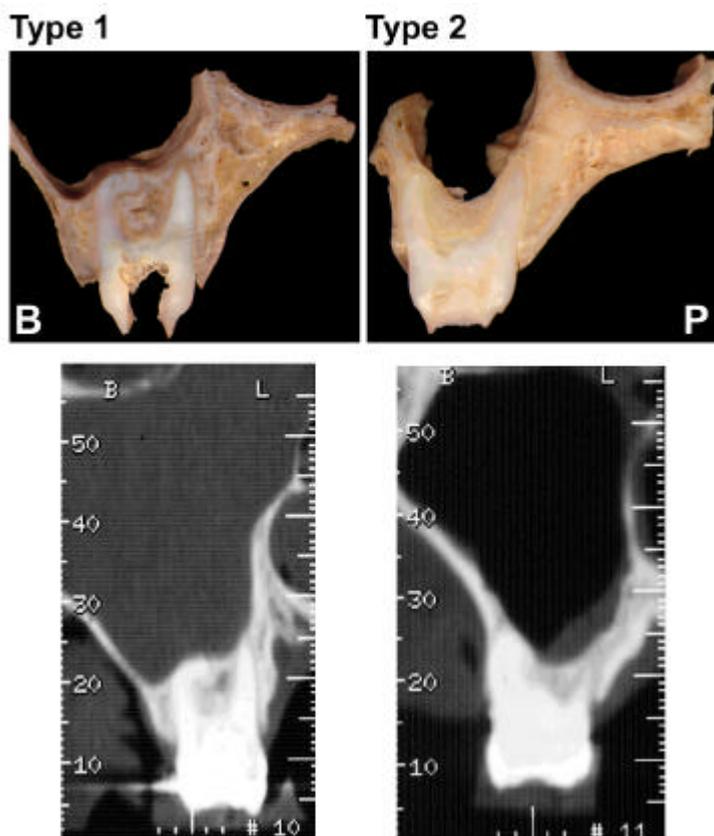| Classifications	Maxillary 1st molar	Maxillary 2nd molar
1	2 (20.0%)	2 (20.0%)
2	8 (80.0%)	8 (80.0%)
3	0 (0.0%)	0 (0.0%)

Numerical is the number of samples observed.

Fig. 9. Classifications of horizontal relationship between the inferior wall of maxillary sinus and the roots of the maxillary molars (B : buccal, P : palatal).

5.   DentaScan

                                                                      DentaScan

                                     3

           (Fig. 10),

        DentaScan

     (Table 7, 8).   (furcation area)

                                 (furcation involvement)   ,

              88.4%   , DentaScan   95.4%

                          ,   2   DentaScan

     100%   .

         ,

           (apical lesion)   ,   DentaScan

                                                 DentaScan

                              (98.6%).

                                                                          (apical

involvement)   ,

                DentaScan

                     .

                                                          , DentaScan

     ,   ,

                                 3

     , DentaScan   97.3%   ,

          90.6%   DentaScan

                (Table 8, Fig. 11).

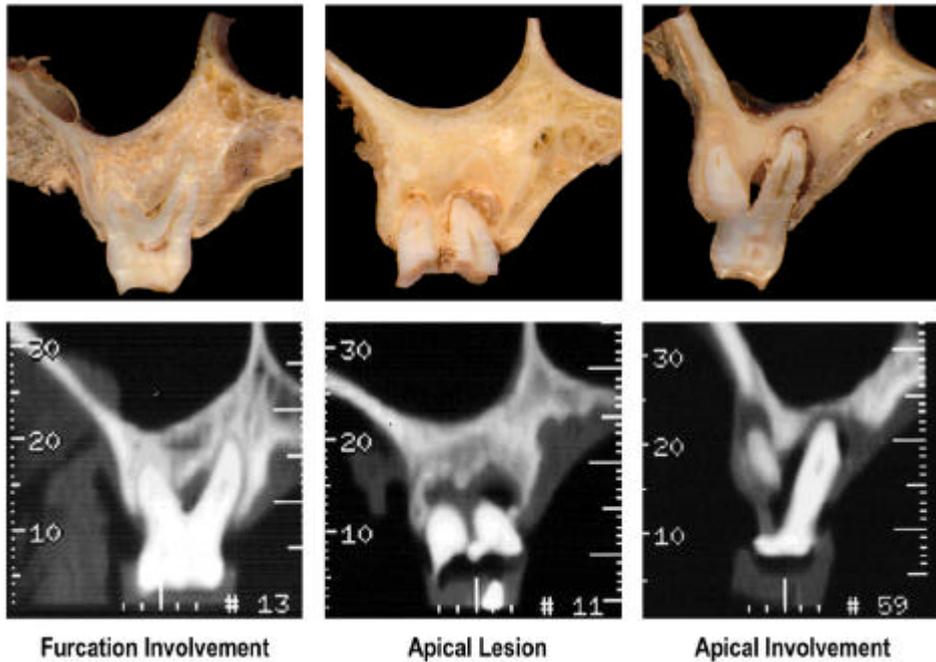**Furcation Involvement**   **Apical Lesion**   **Apical Involvement**

Fig. 10. Photographs of sectioned specimens (upper panel) and DentaScan reformatted cross-sectional images (lower panel) on the same areas. Left panel is shown the furcation involvement of the maxillary 1st molar area, at the middle panel, periapical lesion is observed under the root rest of the maxillary molar. Right panel is shown the apical involvement of the maxillary 2nd molar.

Table 7. Comparisons in the degree of accuracy of the findings of the dental inflammatory pathoses of the periodontal and apical regions of maxillary teeth on the intraoral radiographs and DentaScan reformatted cross-sectional images.

Maxillary tooth	root	Furcation involvement		Apical lesion		Apical involvement	
		Intraoral	DentaScan	Intraoral	DentaScan	Intraoral	DentaScan
1st premolar	palatal			8/8 (100.0)	8/8 (100.0)	10/10 (100.0)	10/10 (100.0)
	buccal			21/21 (100.0)	21/21 (100.0)	19/22 (86.4)	17/22 (77.3)
2nd premolar	palatal			4/4 (100.0)	4/4 (100.0)	4/4 (100.0)	4/4 (100.0)
	buccal			20/20 (100.0)	20/20 (100.0)	18/20 (90.0)	19/20 (95.0)
1st molar	palatal			21/22 (95.5)	22/22 (100.0)	21/22 (95.5)	21/22 (95.5)
	mesio-buccal	21/22 (95.5)	20/22 (90.9)	21/22 (95.5)	21/22 (95.5)	19/22 (86.4)	21/22 (95.5)
	disto-buccal			22/22 (100.0)	20/22 (90.9)	20/22 (90.9)	20/22 (90.9)
2nd molar	palatal			21/21 (100.0)	21/21 (100.0)	21/21 (100.0)	21/21 (100.0)
	mesio-buccal	17/21 (80.9)	21/21 (100.0)	20/21 (95.2)	21/21 (100.0)	21/21 (100.0)	21/21 (100.0)
	disto-buccal			18/19 (94.7)	19/19 (100.0)	19/20 (95.0)	19/20 (95.0)
Total (%)		88.4	95.4	98.1	98.6	94.4	94.9

Intraoral : intraoral radiography,

Nmber of the samples in which finding was corresponded with the specimen / total number observed.

Numerical in parentheses is the incidence (%) of the samples observed.

Table 8. Comparisons in the degree of accuracy of relationships between the apices of maxillary teeth and inferior wall of maxillary sinuses on the intraoral radiographs and DentaScan images.

| Maxillary tooth | root | Relationship between apex and inferior wall of maxillary sinus | |
		Intraoral radiography	DentaScan image
1st molar	palatal	18/22 (81.8)	21/22 (95.5)
	mesio-buccal	20/22 (90.9)	21/22 (95.5)
	disto-buccal	20/22 (90.9)	21/22 (95.5)
2nd molar	palatal	21/21 (100)	21/21 (100)
	mesio-buccal	19/21 (90.5)	20/21 (95.2)
	disto-buccal	19/21 (90.5)	21/21 (100)
Total (%)		90.6	97.3

Number of the samples in which finding was corresponded with the specimen / total number observed.

Numerical in parentheses are incidences (%) of the samples observed.
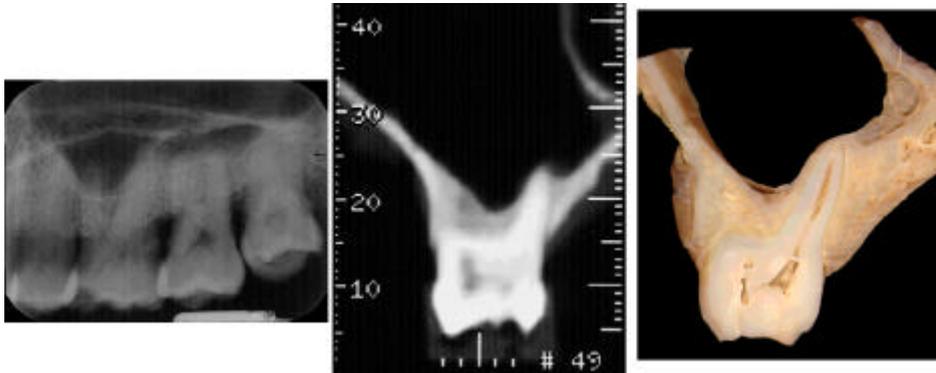
Fig. 11. Photographs of intraoral (left panel), DentaScan reformatted cross-sectioned radiography (middle panel) and cross-sectioned specimen (right panel) on the left maxillary 1st molar area. As shown in photographs, palatal root of 1st molar is shown the apical protrusion over the sinus inferior wall.

IV.

1970 , 1980

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, 3

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2

. ,

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(multiplanar imaging)

.

workstation 3

.

V-works^{TM} 3.0

CT volume rendering

2 3

. V-works^{TM} 3.0

3 ,

3

. 6

,

(I , 24.2%) (II , 21.2%)

50%

. ,

VI   3

,

(Table 2).

.

V - works^{TM} 3.0   3

,   .

,

(Table 3).   32 ,   25 ,   35

^{2} ,

,   .

3

.

.

2   (44.8%)   1

(31.1%),   1   (19.0%)   3

(48.3%)   2   (27.6%),

(24.1%) ^{33}

1   58.4%

(33.3%)   2   (8.3%)

^{33} .

93.9%   .

,   .

1

1, 2 [34]

2 [35] 3

DentaScan

1 , 2 ,

2 ,

[33] .

,

(apical surgery) . ,

.

(Table 4).

1 (1.99), 2

(, 5.48

).

(#1 : width) 2 (

15.19), 1 (11.15)

.

2

(: 2.82 ,

: 2.74 , : 3.40), 1

(: 5.72 , : 6.27).

[10,35] 2

.

0.5

.[3]   ,   ,

.   1

(: 0.44 , : 0.50), 2

(0.55),

1 (: 0.42 , : 0.51), 2 (: 0.40

, : 0.46)

.

1   0.52 ,   2   0.77 ,   1

0.61 ,   2   0.58

.

Table 9   .   1,   2   ,

(#16, PD/a-a)

(#1, width)

(p< .05).   ,

(#10 M/a-h, #13 D/a-h)

(#11 M/a-s, #14 D/a-s)

(p< .05).

(#4 P/a-s, #11 M/a-s, #14 D/a-s)

(#17 P/b, #21 F/b)   (p< .05).

Table 9. Correlations between the items of measurements.

Items of analysis		n	Correlation coefficient	p-value	Items of analysis		n	Correlation coefficient	p-value
Maxillary 1st premolar					Maxillary 2nd molar				
B/a-h	PB/a-a	12	-0.703	0.011	PD/a-a	width	13	0.813	0.001
maxillary 1st molar					P/a-s	F/b	21	-0.456	0.037
P/a-s	P/b	21	0.487	0.025	M/a-s	F/b	17	-0.495	0.042
PD/a-a	width	18	0.527	0.024	D/a-h	D/a-s	16	-0.577	0.019
M/a-h	M/a-s	17	-0.526	0.029	P/a-h	PM/a-a	13	-0.658	0.014
M/a-h	PM/a-a	11	-0.639	0.034	P/a-h	PD/a-a	16	-0.684	0.003
D/a-h	D/a-s	19	-0.507	0.026	M/a-h	PM/a-a	12	-0.594	0.042

(palatine recess),   (infraorbital recess),   (prelacrimal

recess),   (zygomatic recess),   (alveolar recess)

              .   ,

mm

(infraorbital canal)   [36]

                              ,   .

                                                            Fig. 4, 8   5

                                    ,   1, 2   I

(

)   (1   : 54.5%,   2   : 52.4%).

                        II   (

)   1   18.3%,   2

28.6%   .   1   IV

(   ) III   (

)   2

IV   III   14.2%

.

SCANORA$^{®}$

[7]

. SCANORA$^{®}$

1   II

2   I   .

SCANORA$^{®}$ [7]

,   55.8

.

[34,37,38]

.

.   3

1   ,   2   2   (

,   )   80%

,   20%   1   (

)   .   3

.

.

DentaScan

DentaScan   ,

                                                              DentaScan

                                              .

                                                                              .

              .

                                    .

                                                    . DentaScan

                                                                        .

(furcation involvement)

              .

furcation involvement

                                                          .

                              ,   furcation involvement

                                                                        [39].

                              furcation involvement

                                              .

93%   ,

              furcation involvement

                                        .   DentaScan

      furcation involvement   96.7%

                          .   apical

- 40 -

involvement   (94.4%)   DentaScan

(94.9%)   .

Fuhrmann   [4]

DentaScan

, 100%   DentaScan

.   furcation involvement

DentaScan   .

.

DentaScan

.   ,

(98.1%)   DentaScan

(98.6%)

.

(blurring effect)   .

.

DentaScan   .

2

.   ,

3   DentaScan

97.3%   ,

90.6%   .   DentaScan

                                                                                    .

                                        ,   6

                        ,

            .

                                        .

DentaScan   ,

                        DentaScan

                        DentaScan

            .

V.

33

.   DentaScan

DentaScan   .

.

1.   6

,   (18   , 54.5%)   .

1   ,

.

2. 3   ,

39.3   ,   37.1   ,   32.6

.

18.0   ,   11.1   .

3.   2

,   1   .

4.   ,

1

,   2

,   1   ,   2

.

5.

1

(Type I) 12 (54.5%)

, 2

(Type I) 11 (52.4%)

.

6.

1

(Type 2) 8

(80%) 2

,

(Type 2) 8 (80%) .

7. , DentaScan

, ,

DentaScan .

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DentaScan

DentaScan .

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Abstract

Topographical anatomy and radiographic evaluations
of the maxillary sinus and surrounding structures

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The anatomical description and the relationship between the root apex and the inferior wall of sinus are critical in diagnoses and surgeries of the sinus pathoses, and in dental implantation. So, identification of the proximity between the root apex and the inferior wall of sinus and the clarification of cortical thickness of inferior wall of sinus are indicated the topography of spreading dental infection into the maxillary sinus. Therefore, anatomical knowledge of the topography between the root apex and the inferior wall maxillary sinus are important in the diagnosis and treatment planning of the dental implantation, endodontic procedures, and orthodontic treatment.

The purposes of this study were 1) to clarify the morphological and clinical characteristics of the maxillary sinus, especially the inferior wall of sinus in Korean, 2) to identify the relationship between the inferior wall of maxillary sinus and the roots of maxillary teeth, and 3) to evaluate the degree of accuracy of DentaScan reformatted images of the maxillary sinus.

33 sides of maxillae of the hemi-sectioned Korean heads were used in this study. Periapical radiographs, computed tomography and DentaScan reformatted

cross-sectional images were taken for the radiographic evaluation of the maxillary teeth and inferior wall of maxillary sinus. From the CT images, 3-dimentional reconstructive images of maxillary sinuses were made using the V-works^{TM} 3.0 program. All specimens were decalcificated and then were sectioned coronally. On the sectioned specimen, 21 metric items were measured using the image analyzing system.

The results were as follows:

1. In 6 categories of maxillary sinus according to their lateral aspects and shapes of the inferior walls, flat (54.5%) and round (21.2%) inferior wall of maxillary sinus were prominent. In 58.4%, the anterior limit of maxillary sinus was located in the 1st premolar area and the posterior limit was in the 3rd molar and maxillary tuberosity area (93.9%). The lowest level of the maxillary sinus was in the 1st molar and 2nd molar area.

2. From the 3-dimensional reconstructive images of maxillary sinus, the maximum A-P length of sinus was 39.3± 4.2 , the maximum height was 37.1 ± 5.6 , and the maximum width was 32.6± 6.5 . And the average volume of sinus was 15.1± 6.2 . All measurements were larger in male than female.

3. The distance between the each root apex and the inferior wall of maxillary sinus was the shortest in the 2nd molar area and the longest in the 1st premolar area.

4. The thickness of the cortical plate of the inferior wall of maxillary sinus was thinnest in the 1st premolar area, whereas, the thickest in the 2nd premolar area.

5. The vertical relationship between the inferior wall and the roots of the maxillary molars was classified into 5 types. Type I (the inferior wall of sinus was located above the level connecting the buccal and lingual root apices) was

predominant (54.5% in the 1st molar area, 52.4% in the 2nd molar area).

6. The horizontal relationship between the inferior wall of sinus and root apex were classified into 3 types. Type 2 (the alveolar recess of the inferior wall of sinus was located between the buccal and lingual roots) was predominant (80% in the 1st and 2nd molar area).

7. Compared the degree of accuracy and findings of dental and periapical pathoses on the intraoral radiographs and DentaScan reformatted images with the cross-sectioned specimens, the DentaScan reformatted cross-sectional images were more accurate and more effective than the intraoral radiography with a viewpoint of the detection of dental and periapical pathoses.

Summarizing all these results, this study demonstrated that all the measurements of maxillary sinus were larger in males than females. Also morphological measurements of maxillary sinus and surrounding structures have provided the useful measurement data in clinical procedures. Comparing the results of specimens with intraoral radiographies and DentaScan reformatted images, the dental and periodontal pathoses and topographical structures were more clearly observed in the DentaScan reformatted images, providing the possibility of more applications of reformatted images to clinical dentistry.