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Morphological analysis with Cone Beam Computed Tomography of the maxillary sinus in maxillary displaced canine subjects

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ABSTRACT

Background: The upper permanent canine tooth germ develops close to maxillary sinus (MS)[1] therefore, upper canine displacement and MS pneumatization may have a link.[2] This study aims to evaluate the MS dimensions, volume, and range of anterior and vertical MS pneumatization in bilaterally palatally (PDCs) and buccally displaced maxillary canine (BDCs) compared to normally erupted canine (NDCs) subjects.

Methods: Cone-Beam-Computed-Tomography (CBCT) images of 167 patients (131 females/33 males, age averaged 18.88 ± 1.66 years) were included in the study. Maxillary canines were bilaterally displaced palatally in 60 patients, buccally in 57 patients, and normally erupted in 50 subjects. The following variables were measured: anterior, lateral, and vertical distance from canine cusp tip to MS wall, MS volume and dimensions, and MS anterior and inferior pneumatization. The paired sample t-test was applied to detect differences between the right and left sides. Differences between the three groups were assessed using Chi-square and ANOVA one-way analysis tests.

Results: More anterior MS pneumatization was detected in maxillary displaced canines compared to NDCs' subjects. MS was extended to the incisor region in 20%, 10%, and 4%, and to canine region in 10%,12%, and 24.5% in PDCs, BDCs, and NDCs subjects, respectively ($X_2 = 19.22$, $p = 0.014$). Significant differences between the right and left sides were detected, subsequently, right and left sides values were averaged (Table 1). PDCs subjects had a smaller lateral distance from the canine tip to MS wall compared to BDCs subjects ($p < 0.05$) and a reduced average vertical position of the canine tip to MS compared to NDCs subjects ($P < 0.001$). BDCs subjects had a larger vertical distance from canine tip to MS ($p < 0.001$), an increased MS volume ($p < 0.01$), and a reduced MS width ($p < 0.05$).

Conclusion: MS showed anterior pneumatization in subjects with maxillary displaced canines. In BDCs' subjects, MS showed lateral pneumatization. MS width and volume were larger in BDCs subjects compared to PDCs and NDCs subjects.

Keywords: Maxillary sinus, Displaced Canines, Cone Beam Computed Tomography, Volume, Dimensions

Table 1. Means, standard deviation (SD) of the maxillary sinus variables for the right and left sides of bilaterally displaced and non-displaced maxillary canine subjects, differences between means, standard error (SE) of mean differences, and significance for the 3 studied groups.

Variable	Right side Mean (SD)	Left side Mean (SD)	Differences between means (SE)	T value	Right and Left sides averaged value (SD)
BDCs (n=57 subjects)					
Ant. distance canine tip-MS (mm)	1.70 (6.38)	1.17 (6.95)	0.53 (0.58)	0.92NS	1.44 (6.30)
Lat. distance canine tip-MS (mm)	23.15 (4.50)	23.24 (4.34)	-0.09 (0.61)	-0.15NS	23.19 (3.77)
Vert. Distance canine tip-MS (mm)	6.55 (4.45)	8.70 (5.80)	-2.15 (0.630	-3.40***	7.62 (4.57)
MS volume (cm³)	11.31 (5.02)	10.17 (5.30)	1.14 (0.50)	2.27*	10.74 (4.79)
MS length (mm)	33.51 (4.01)	32.24 (4.86)	1.27 (0.86)	1.48NS	32.88 (3.02)
MS width (mm)	25.96 (4.90)	25.97 (5.97)	-0.01 (0.77)	-0.01NS	25.96 (4.42)
MS height (mm)	27.44 (6.02)	27.82 (5.91)	-0.38 (0.74)	-0.51NS	27.63 (5.26)
Vert. distance 1ˢᵗ molar root-MS (mm)	-0.21 (2.02)	-0.05 (1.76)	-0.16 (0.17)	-0.93NS	-0.13 (1.78)
PDCs (n=60 subjects)					
Ant. distance canine tip-MS (mm)	2.43 (6.54)	3.23 (7.44)	-0.80 (0.86)	-0.93NS	2.83 (6.15)
Lat. distance canine tip-MS (mm)	21.50 (3.11)	22.15 (5.53)	-0.65 (0.78)	0.83NS	21.83 (3.31)
Vert. Distance canine tip-MS (mm)	7.57 (5.25)	7.39 (4.70)	0.19 (0.71)	-0.26NS	7.48 (4.15)
MS volume (cm³)	10.11 (2.98)	8.16 (4.42)	1.96 (0.43)	0.39***	9.14 (2.32)
MS length (mm)	33.32 (4.00)	33.06 (4.48)	0.26 (0.60)	0.44NS	33.19 (3.56)
MS width (mm)	25.68 (4.63)	24.52 (5.23)	1.16 (0.65)	1.79NS	25.10 (4.26)
MS height (mm)	28.11 (5.04)	27.56 (1.84)	0.56 (0.74)	0.75NS	27.84 (4.65)
Vert. distance 1ˢᵗ molar root-MS (mm)	0.07 (1.84)	-0.02 (1.92)	0.10 (0.23)	0.41NS	0.03 (1.65)
NDCs (n=50 subjects)					
Ant. distance canine tip-MS (mm)	0.46 (6.64)	1.15 (5.16)	-0.69 (0.86)	-0.81NS	0.81 (5.13)
Lat. distance canine tip-MS (mm)	22.11 (4.29)	22.20 (5.70)	-0.09 (0.98)	-0.09NS	22.16 (3.70)
Vert. Distance canine tip-MS (mm)	3.51 (4.71)	4.28 (4.17)	-0.77 (0.67)	-1.14NS	3.90 (3.77)
MS volume (cm³)	9.11 (3.40)	7.96 (2.97)	1.15 (0.46)	2.49*	8.53 (2.75)
MS length (mm)	32.75 (4.39)	32.66 (4.25)	0.10 (0.75)	0.13NS	32.71 (3.44)
MS width (mm)	24.37 (5.34)	23.42 (5.05)	0.96 (0.83)	1.16NS	23.90 (4.13)
MS height (mm)	28.56 (5.97)	27.38 (6.15)	1.18 (0.89)	1.33NS	27.97 (5.20)
Vert. distance 1ˢᵗ molar root-MS (mm)	0.01 (1.82)	0.19 (2.05)	-0.18 (0.32)	-0.54NS	0.10 (1.57)

NS: non-significant, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 2. Differences between means and standard error (SE) of the maxillary sinus variables, 95% confidence intervals (C.I.) of the mean differences, and significance between the 3 studied groups.

Variable	PDC & NDC Differences between means (SE)	95% C.I of the differences	p-value	PDC & BDC Differences between means (SE)	95% C.I of the differences	p-value	BDC & NDC Differences between means (SE)	95% C.I of the differences	p-value
Ant. distance canine tip-MS (mm)	-2.02 (1.14)	-4.28-0.23	0.078NS	-1.39 (1.09)	-3.54-0.76	0.203NS	-0.63 (1.15)	-2.90-1.64	0.583NS
Lat. distance canine tip-MS (mm)	0.33 (0.69)	-1.03- 1.70	0.633NS	1.36 (0.66)	0.06-2.67	0.041*	-1.03 (0.70)	-2.41- 0.34	0.140NS
Vert. Distance canine tip-MS (mm)	-3.59 (0.81)	-5.18--1.98	0.000***	0.14 (0.77)	-1.39- 1.67	0.857NS	-3.73 (0.81)	-5.33--2.12	0.000***
MS volume (cm³)	-1.01 (0.75)	-2.50- 0.48	0.182NS	1.19 (0.72)	-0.23- 2.62	0.100NS	-2.21 (0.79)	-3.71--0.70	0.004**
MS length (mm)	-0.48 (0.68)	-1.75- 0.79	0.457NS	-0.31 (0.62)	-1.52- 0.91	0.618NS	-0.17 (0.64)	-1.46- 1.09	0.790NS
MS width (mm)	0.86 (0.82)	-0.76- 2.48	0.297NS	-1.21 (0.79)	-2.76- 0.34	0.126NS	-2.07 (0.83)	0.43- 3.70	0.013*
MS height (mm)	0.13 (0.97)	-1.78- 2.05	0.892NS	-0.21 (0.93)	-2.04- 1.62	0.824NS	0.34 (0.98)	-1.59- 2.27	0.729NS
Vert. distance 1ˢᵗ molar root-MS (mm)	0.08 (0.32)	-0.41- 0.88	0.472NS	-0.16 (0.31)	-0.77- 0.45	0.610NS	0.23 (0.32)	-0.41-0.87	0.472NS

NS: non-significant, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Ethical approval/IRB statement: This study was reviewed and approved by the Research Ethical Committee, Jordan University of Science and Technology (Approval number: 145/132/2020), Irbid, Jordan.

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