

Table 1 Selected variables from studies of molar intrusion

	Intrusion	Pg	Pg'	N-Me/LAFH	Me'	Lower lip	Overjet	Overbite
Sherwood et al. [19] ^a	– 1.99 ^g			– 2.62 ^g				3.62 ^g
Sugawara et al. [18] ^a	– 1.7 (0.91)			– 1.5 ^g			– 1.3 ^g	4.9 ^g
Erverdi et al. [20] ^a	– 2.6 (1.39)						– 2.0 (2.53)	3.7 (2.4)
Erverdi et al. [23] ^b	– 3.6 (1.4)			– 2.9 (1.3)			– 1.4 (1.5)	5.1 (2.0)
Kuroda et al. [24] ^a	– 2.3 (2.0)			– 3.6 (1.8)			3.6 (2.4)	6.8 (1.7)
Xun et al. [25] ^b	– 1.8 (0.7)	2.5 (2.6) ^c		– 1.6 (0.9)			– 2.0 (2.2)	4.2 (0.9)
Lee and Park [26] ^a	– 2.2 (1.7)	2.17 (2.47)		– 2.63 (1.96)				5.47 (1.86)
Akay et al. [27] ^b	– 3.4 ^g			– 3.7 ^g				4.8 ^g
Baek et al. [28] ^a	– 2.39 (1.76)	2.4 (2.32)		– 2.53 (1.9)				5.56 (1.94)
Buschang et al. [29] ^a	N/A	2.4 (2.3)	N/A	N/A	N/A	N/A	N/A	N/A
Deguchi et al. [30] ^a	– 2.3 (1.3)			– 2.6 (2.5)		– 3.1 (2.7) ^d	– 3.0 (2.9)	6.2 (1.7)
Akan et al. [31] ^b	– 3.37 (1.21)			– 4.16 (1.71)		– 0.42 (1.17) ^e	– 1.68 (2.0)	4.79 (1.36)
Foot et al. [32] ^b	– 2.9 (0.8)			– 0.9 (1.1)			– 0.1 (1.2)	3.0 (1.5)
Scheffler et al. [33] ^b	– 2.3 (1.4)			– 1.6 (2.2)				2.2 (1.6)
Hart et al. [34] ^b	– 2.3 (0.06)			– 1.5 (0.03)			– 1.1 (1.4)	3.8 (0.94)
Marzouk et al. [35] ^b	– 3.1 (0.74)						– 1.7 (0.82)	6.55 (1.83)
Marzouk and Kassem [36] ^a	– 3.04 (0.79)	2.45 (0.05)	N/A	– 3.57 (1.15)	N/A	N/A	– 3.39 (2.04)	6.93 (1.99)
Marzouk and Kassem [37] ^a	– 3.04 (0.79)	N/A	2.43 (0.47)	N/A	– 3.12 (0.58)	– 1.15 (0.22) ^d – 1.23 (0.05) ^e 1.78 (0.74) ^f	N/A	N/A

^aMeasurements taken post-treatment and extractions were involved^bMeasurements taken post-intrusion^cMeasured at point B^dMeasured to Sn-Pg'^eMeasured to E-line^fMeasured to true vertical^gS.D. not reported

tissue measurements. Intraclass correlation coefficients between examiners were greater than 0.87 and 0.79 for hard and soft tissue measurement, respectively. Ratios between pairs of measurements were calculated. The data were verified for normality of the measurements using histograms and Shapiro-Wilk tests. Scatter plots were used to confirm linearity and homoscedasticity. Paired *t* tests were used to compare pre-intrusion and post-intrusion variables. Pearson product moment correlation tests were performed to calculate regression coefficients and derive regression equations. The statistical analysis was done using the Statistical Package for the Social Science (SPSS, Version 20). Significance level was set at $P \leq 0.05$ for paired *t* comparisons. Bonferroni correction was used to avoid type I error with multiple correlation testing; hence, significance level was set at $P \leq 0.01$.

Results

Table 2 shows selected variables before and after maxillary posterior teeth intrusion where the selected variable showed statistically significant differences.

Mean ratios between the amount of intrusion measured at the maxillary first molar and selected variables are reported in Table 3. The hard tissue chin point and the soft tissue chin points moved forward 79 and 80%, respectively, of the distance the maxillary first molar was intruded. The facial height at Me and Me' decreased at approximately 1:1 of the maxillary first molar intrusion. The overbite was found to deepen two fold, whereas the overjet was reduced by 61% of the maxillary molar movement. The lower lip moved horizontally 83% of the amount of intrusion.

Linear regression showed that upper molar intrusion was a significant predictor for all the selected variables (Table 4). Regression equations explained more than 50% of the variation of Pg-VRL, Me-HRL, overbite, overjet, and Me'-HRL. Less than 30% in the variability of Pg'-VRL and labrale inferius (Li)-VRL could be explained by the regression equations. Using the obtained regression equations, a typical 3-mm molar intrusion will result in 2.36 and 2.48 mm forward movement of Pg ($r = -0.88$, $P \leq 0.001$) and Pg' ($r = -0.4$, $P \leq 0.01$),