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The Effect of Using FTMPF versus Low Level Laser Application on Orthodontic Tooth Movement Acceleration

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Results

This study was done to evaluate the acceleratory effect of elevation of only full thickness mucoperiosteal flap only and low level laser therapy on OTM. It was a split mouth study design(within each group a test side and control side) with 4 groups distributed as following:

Group 1:

Group 1.a.Full thickness mucoperiosteal flap (8 sides)

Group 1.b. Control (8 sides)

Group 2:

Group 2.a. Low level laser application. (8 sides)

Group 2.b. Control.(8 sides).

Descriptive Failure:

a- Drop Out:

There was one patient on Group 1 skipped the planned follow up visits for records taking included T1 and T3. So this patient was excluded. Therefore, Group 1 became 7 subjects instead of 8. This was within the precalculated drop-out rate (10%).

b- Miniscrew Failure:

Along the study time and over 32 miniscrews were inserted, 3 minis crews failure were occurred. It was in the form of screw mobility. In those cases, once mobility was felt in the follow up visits, the same miniscrew was removed and immediately reinserted in higher level. Except in one patient, the miniscrew was replaced with other one with larger diameter. The loading retraction force was then rechecked by force gauge.

Statistical analysis

The data were collected and tabulated, where the values were presented as median (minimum – maximum), mean and standard deviation. As the data were not normally distributed, the difference between the two techniques was evaluated by Mann-Whitney U test. While the difference between each technique and its control was assessed using Wilcoxon Signed Ranks test. All tests were bilateral and a P value of 5% was the limit of statistical significance. Analysis was performed by statistical package software IBM- SPSS version 21.

These results include:

1- Descriptive data and statistical analysis of the mean distance moved by maxillary canine.

2- Descriptive data and statistical analysis of the weekly rate of maxillary canine retraction.

3- Descriptive data and statistical analysis of total weeks were needed to complete canine retraction

4- Descriptive data and statistical analysis of the mesial movement amount of first maxillary molar after full maxillary canine retraction

5- Descriptive data and statistical analysis of the amount change in average maxillary canine periodontal pocket depth after full maxillary canine retraction for:

- Group 1 with FTMPF side and its Control side at different intervals
- Group 2 with LLLT side and its Control side at different intervals
- Group 1a FTMPF vs Group 2a LLLT.
- Both groups control.

Section 1

The Mean Distance Moved by Maxillary Canine

In Group 1 ; FTMPF group versus its Control group

The descriptive data of the mean distance moved by maxillary canine (median, minimum, maximum, mean and standard deviation values) in the different time intervals (I1, I2, I3. I4 and Overall I5) were shown in detail in Table (2). (Fig. 42)

The mean overall distances moved by maxillary canine in FTMPF and its Control were 6.77mm (0.32) and 6.70mm (0.35) respectively. Comparing the difference in mean distance moved by maxillary canine in both groups, was assessed using Wilcoxon Signed Ranks test. It is a bilateral nonparametric test and P value of 5% is the limit of statistical significance. Wilcoxon Signed Ranks test revealed that the differences between both groups in the overall distance was statistically not significant, (Table 3)

Section 1

The Mean Distance Moved by Maxillary Canine

Table 1: Descriptive data of the mean distance moved by maxillary canine in group 1 with FTMPF side and its control side at different intervals:

Intervals	Side	N	Mean Distance Moved by Maxillary canine				
			Median (mm)	Minimum (mm)	Maximum (mm)	Mean	St D
I1	FTMPF	7	0.490	0.41	0.61	0.49	0.08
	Control	7	0.390	0.29	0.43	0.36	0.05
I2	FTMPF	7	1.300	1.10	1.42	1.30	0.11
	Control	7	0.700	0.61	0.91	0.73	0.12
I3	FTMPF	7	2.660	2.50	3.02	2.71	0.17
	Control	7	3.1100	2.57	3.35	2.97	0.34
I4	FTMPF	7	0.220	0.01	0.50	0.25	0.20
	Control	7	0.5200	0.27	0.54	0.45	0.11
I5 (Overall)	FTMPF	7	6.840	6.27	7.13	6.77	0.32
	Control	7	6.7300	6.19	7.22	6.70	0.35

Section 1

The Mean Distance Moved by Maxillary Canine

Table 2: Statistical comparison of the mean distance moved by maxillary canine in group 1 between FTMPF side and its control side at different intervals by Wilcoxon Signed Ranks test

Intervals	Mean Distance Moved by Maxillary canine FTMPF vs control	
	Z	Asymp. Sig. (2-tailed)
I1	-2.366^b	0.018*
I2	-2.366^b	0.018*
I3	-1.859^c	0.063
I4	-1.690^c	0.091
I5 (Overall)	-1.355^b	0.176

a. Values with * are statistically significant with P value <0.05

b. Based on positive ranks.   c. Based on negative ranks.

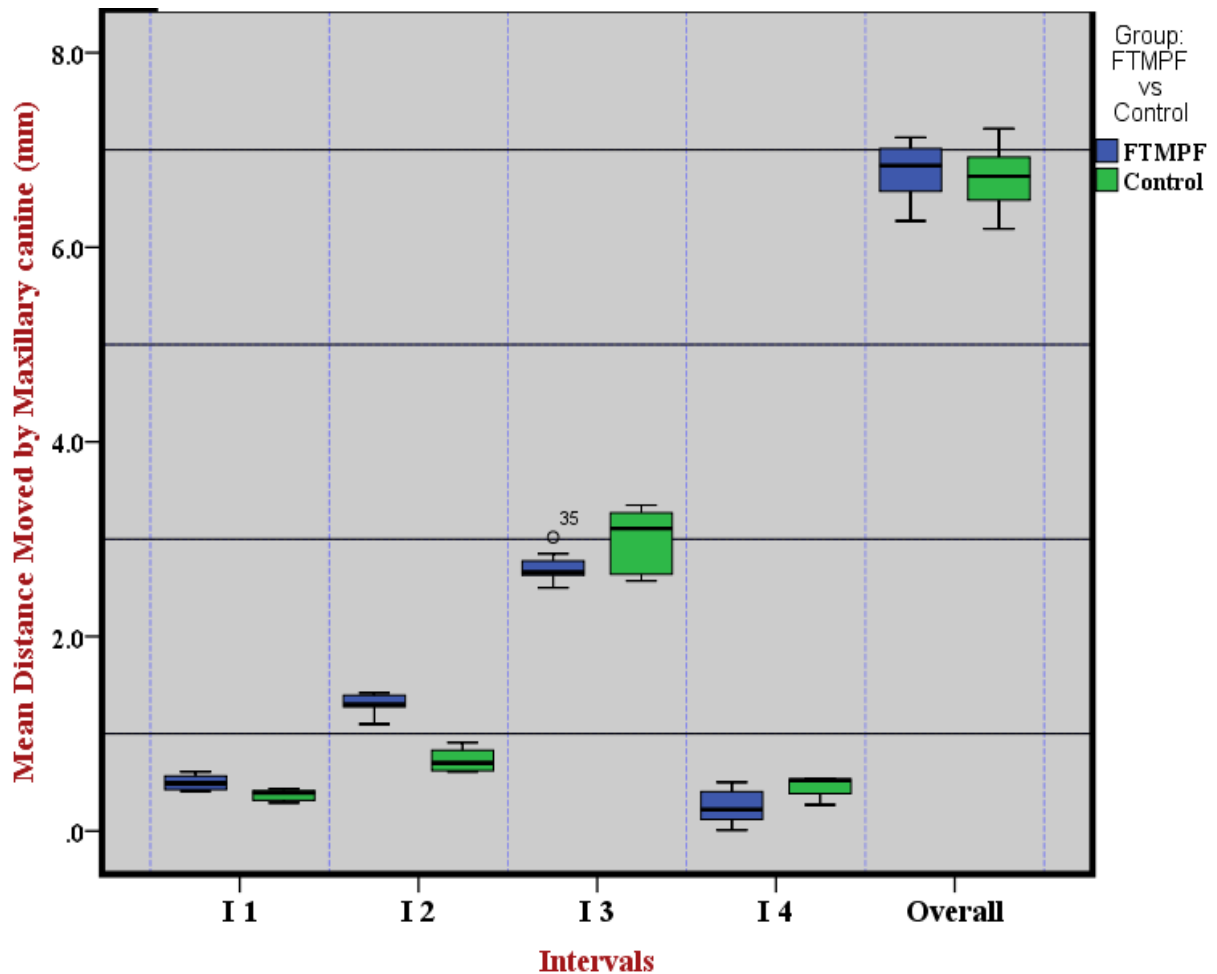## Section 1

The Mean Distance Moved by Maxillary Canine

Figure 42: Boxplot chart showing the mean distance moved by maxillary canine in FTMPF and its control.

Section 1

The Mean Distance Moved by Maxillary Canine

In Group 2 ; LLLT group versus its Control group

The descriptive data of the mean distance moved by maxillary canine (minimum, maximum, median ,mean and standard deviation values) in the different time intervals(I1, I2, I3. I4 and Overall I5) were shown in detail in Table (4). (Fig. 43)

The mean overall distances moved by maxillary canine in LLLT and its Control were 6.88mm(0.24) and 6.55 mm(0.24) respectively. Comparing the difference in mean distance moved by maxillary canine between both groups, was assessed using Wilcoxon Signed Ranks test. It is bilateral test and P value of 5% is the limit of statistical significance. Wilcoxon Signed Ranks test revealed that the differences between both groups in the overall distance was statistically not significant, (Table 5)

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Section 1

The Mean Distance Moved by Maxillary Canine

Table 3: Descriptive data of the mean distance travelled by maxillary canine in group 2 with LLLT side and its control side at different intervals:

| Intervals | side | N | Mean distance moved by maxillary canine | | | | |
			Median (mm)	Minimum(mm)	Maximum (mm)	Mean	St D
I1	LLLT	8	0.420	0.31	0.45	0.39	0.06
	Control	8	0.415	0.031	0.45	0.38	0.06
I2	LLLT	8	0.990	0.81	1.19	1.01	0.11
	Control	8	0.690	0.58	0.79	0.68	0.07
I3	LLLT	8	2.980	2.86	3.16	2.99	0.09
	Control	8	2.0550	1.61	2.45	2.04	0.26
I4	LLLT	8	0.1600	0.03	1.88	0.38	0.61
	Control	8	0.265	0.17	0.56	0.31	0.12
I5 (Overall)	LLLT	8	6.900	6.56	7.29	6.88	0.24
	Control	8	6.565	6.26	6.97	6.55	0.24

Section 1

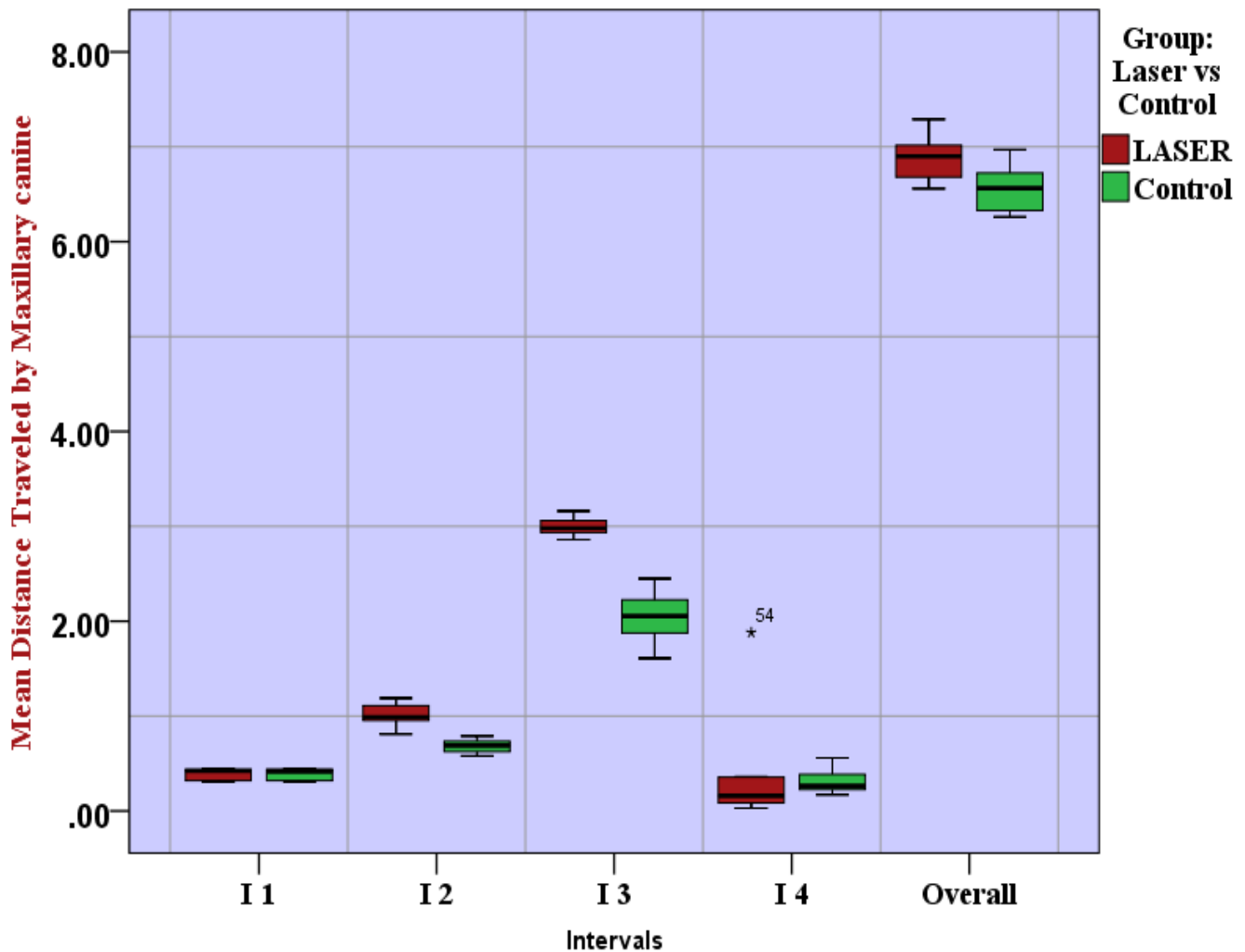## The Mean Distance Moved by Maxillary Canine

Figure43: Boxplot chart showing the mean distance moved by maxillary canine in LLLT and its control.

Section 1

The Mean Distance Moved by Maxillary Canine

Table 4: Statistical comparison of the mean distance moved by maxillary canine in group 2 between LLLT side and its control side at different intervals by Wilcoxon Signed Ranks test

Intervals	Mean distance moved by maxillary canine LLLT vs control	
	Z	Asymp. Sig. (2-tailed)
I1	-0.577[b]	0.564
I2	-2.521[b]	0.012*
I3	-2.524[b]	0.012*
I4	-0.840[c]	0.401
I5 (Overall)	-2.524[b]	0.012*

a. Values with * are statistically significant with P value <0.05
b. Based on positive ranks.   c. Based on negative ranks.

Section 1

The Mean Distance Moved by Maxillary Canine

Group 1a ; FTMPF versus Group 2a; LLLT:

Comparing the difference in the mean distance moved by maxillary canine between Group 1.a (FTMPF) and Group 2.a (LLLT), was evaluated by Mann-Whitney U test. It is a nonparametric bilateral test and P value of 5% is the limit of statistical significance. Mann-Whitney U test revealed that the differences between both groups in overall distance was statistically not significant, (Table 6) (Fig. 44).

Mann-Whitney U test revealed that the differences in controls in Group1b and Group 2b in overall distance were statistically not significant, in order to exclude the cross over reaction.(Table 7)

Section 1

The Mean Distance Moved by Maxillary Canine

Table 5: Statistical comparison of the mean distance moved by maxillary canine in   between group 1a: FTMPF and group 2a: LLLT at different intervals by Mann-Whitney U test

| Intervals | Mean distance moved by maxillary canine | | | | |
| | FTMPF vs LLLT | | | | |
	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
I1	12.000	48.000	-1.862	0.063	0.072[b]
I2	2.500	38.500	-2.954	0.003	0.001[b]*
I3	5.500	33.500	-2.606	0.009	0.006[b] *
I4	27.000	63.000	-.116	0.908	0.955[b]
I5 (Overall)	25.000	53.000	-.347	0.728	0.779[b]

a. Values with * are statistically significant with P value <0.05

b. Grouping Variable: Group   c. Not corrected for ties.

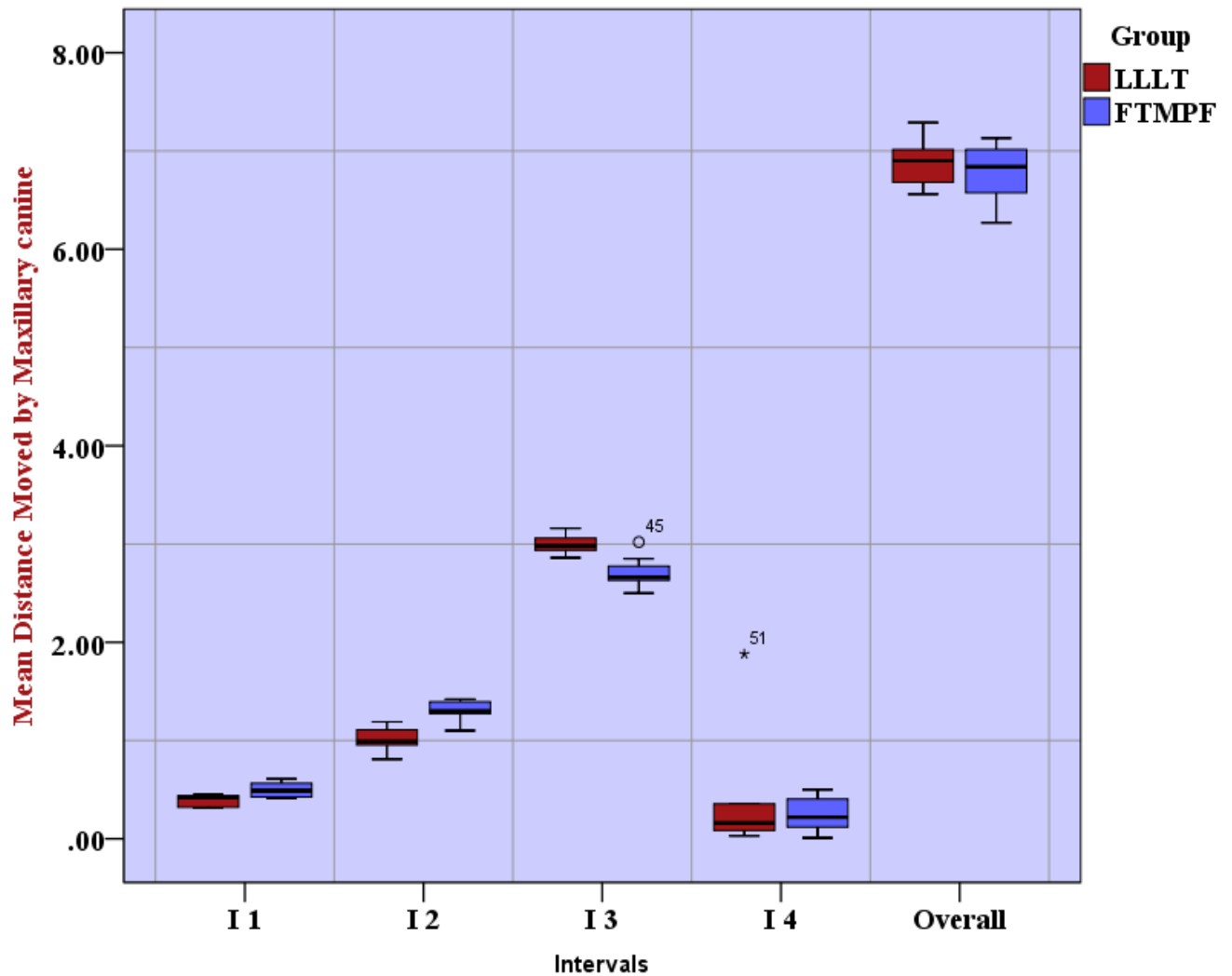## Section 1

The Mean Distance Moved by Maxillary Canine

Figure 44:Boxplot chart showing the mean distance moved by maxillary canine in FTMPF and LLLT.

Section 1

The Mean Distance Moved by Maxillary Canine

Table 6: Statistical comparison of the mean distance moved by maxillary canine in between group 1b and group 2b controls by Mann-Whitney U test

| | Mean distance moved by maxillary canine | | | | |
| | FTMPF vs LLLT | | | | |
	Mann-Whitney U	**Wilcoxon W**	**Z**	**Asymp. Sig. (2-tailed)**	**Exact Sig. [2*(1-tailed Sig.)]**
The mean distance moved by maxillary canine	20.000	56.000	-.926	.355	.397[b]

a. Values with * are statistically significant with P value <0.05

b. Grouping Variable: Group   c. Not corrected for ties.

Section 2

The Weekly Rate of Maxillary Canine Retraction

In Group 1 ; FTMPF Group versus its Control group

The descriptive data of the mean weekly rate of maxillary canine retraction (minimum, maximum, median ,mean and standard deviation values) in the different time intervals (I1, I2, I3. I4 and Overall I5) were shown in detail in (Table 8) (Fig.45,46).

The mean overall weekly rate of maxillary canine retraction FTMPF and its Control were 0.37mm/week (0.02) and 0.29mm/week(0.02) respectively. Comparing the difference in weekly rate of maxillary canine retraction between Group 1.a (FTMPF) and Group 1.b (its control), was assessed using Wilcoxon Signed Ranks test. It is bilateral test and P value of 5% is the limit of statistical significance. Wilcoxon Signed Ranks test was done to reveal the significance differences between both groups in each interval. The overall weekly rate showed statistically significant difference between FTMPF and its control . (Table 9)

Section 2

The Weekly Rate of Maxillary Canine Retraction

Table 7: Descriptive data of the weekly rate of maxillary canine retraction in group 1 with FTMPF side and its control side at different intervals:

Interval	Side	N	Weekly rate of Maxillary Canine Retraction				
			Median (mm/week)	Minimum (mm/week)	Maximum (mm/week)	Mean	St. D
I1	FTMPF	7	0.245	0.21	0.31	0.24	0.04
	Control	7	0.195	0.15	0.22	0.18	0.02
I2	FTMPF	7	0.325	0.28	0.36	0.32	0.02
	Control	7	0.175	0.15	0.23	0.18	0.03
I3	FTMPF	7	0.332	0.31	0.38	0.33	0.02
	Control	7	0.388	0.32	0.42	0.37	0.04
I4	FTMPF	7	0.110	0.01	0.25	0.12	0.10
	Control	7	0.260	0.14	0.27	0.22	0.05
I5 (Overall)	FTMPF	7	0.396	0.37	0.43	0.37	0.02
	Control	7	0.309	0.26	0.33	0.29	0.02

Section 2

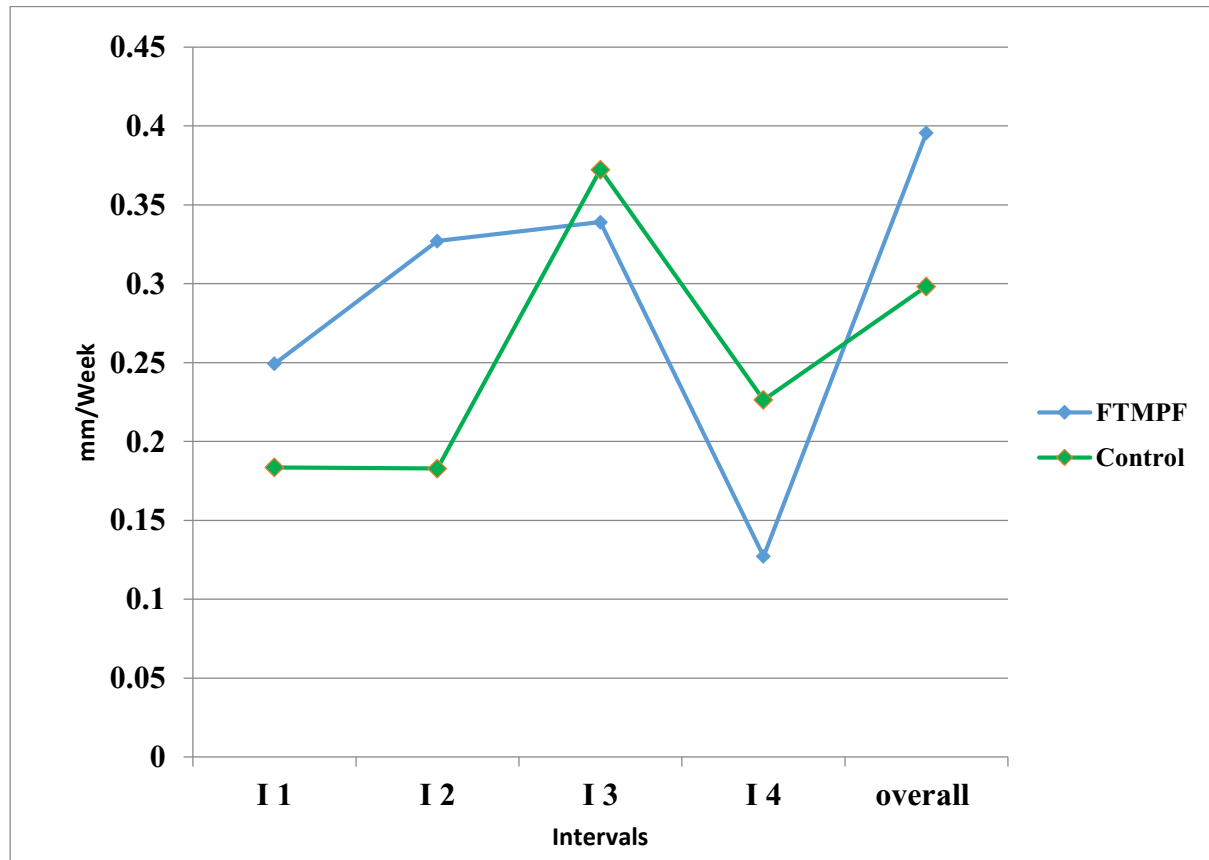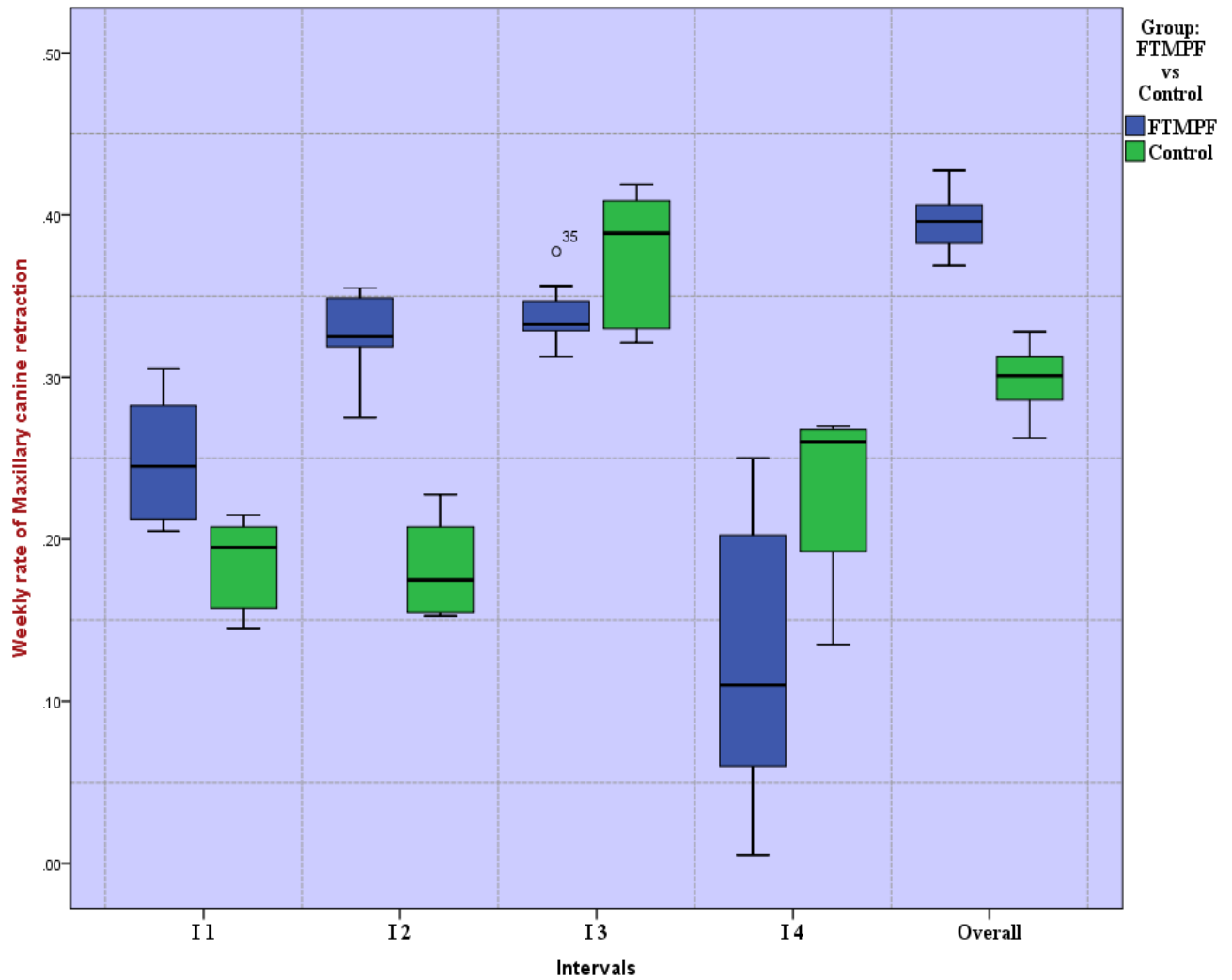## The Weekly Rate of Maxillary Canine Retraction

Figure 45: Line graph showing the weekly rate of maxillary canine retraction in group 1 (FTMPF and its control)

Section 2

The Weekly Rate of Maxillary Canine Retraction

Figure46: Boxplot Graph showing the weekly rate of maxillary canine retraction in group 1 (FTMPF and its Control)

Section 2

The Weekly Rate of Maxillary Canine Retraction

Table 8: Statistical comparison of the difference in weekly rate of maxillary canine retraction in group 1 between FTMPF Side and its control side at different intervals by Wilcoxon Signed Ranks test

Intervals	Weekly rate of maxillary canine retraction FTMPF vs control	
	Z	**Asymp. Sig. (2-tailed)**
I1	-2.366[b]	0.018*
I2	-2.366[b]	0.018*
I3	-1.859[c]	0.063
I4	-1.690[c]	0.091
I5 (Overall)	-2.366[b]	0.018*

a. Values with * are statistically significant with P value <0.05

b. Based on positive ranks.

c. Based on negative ranks.

Section 2

The Weekly Rate of Maxillary Canine Retraction

In Group 2 ; LLLT Group versus its Control group

The weekly rate of maxillary canine retraction (median, minimum, maximum, mean and standard deviation values) in the different time intervals (I1, I2, I3. I4 and Overall I5) are shown in detail in Table (10). (Fig.47,48)

The mean overall weekly rate of maxillary canine retraction LLLT and its Control were(0.38mm/week ±0.013 and 0.28mm/week±0.013) respectively. Comparing the difference in weekly rate of maxillary canine retraction between both groups, was assessed using Wilcoxon Signed Ranks test. It is a bilateral test and P value of 5% is the limit of statistical significance. In the overall weekly rate there was statistically significant difference between LLLT and its control (Table 11)
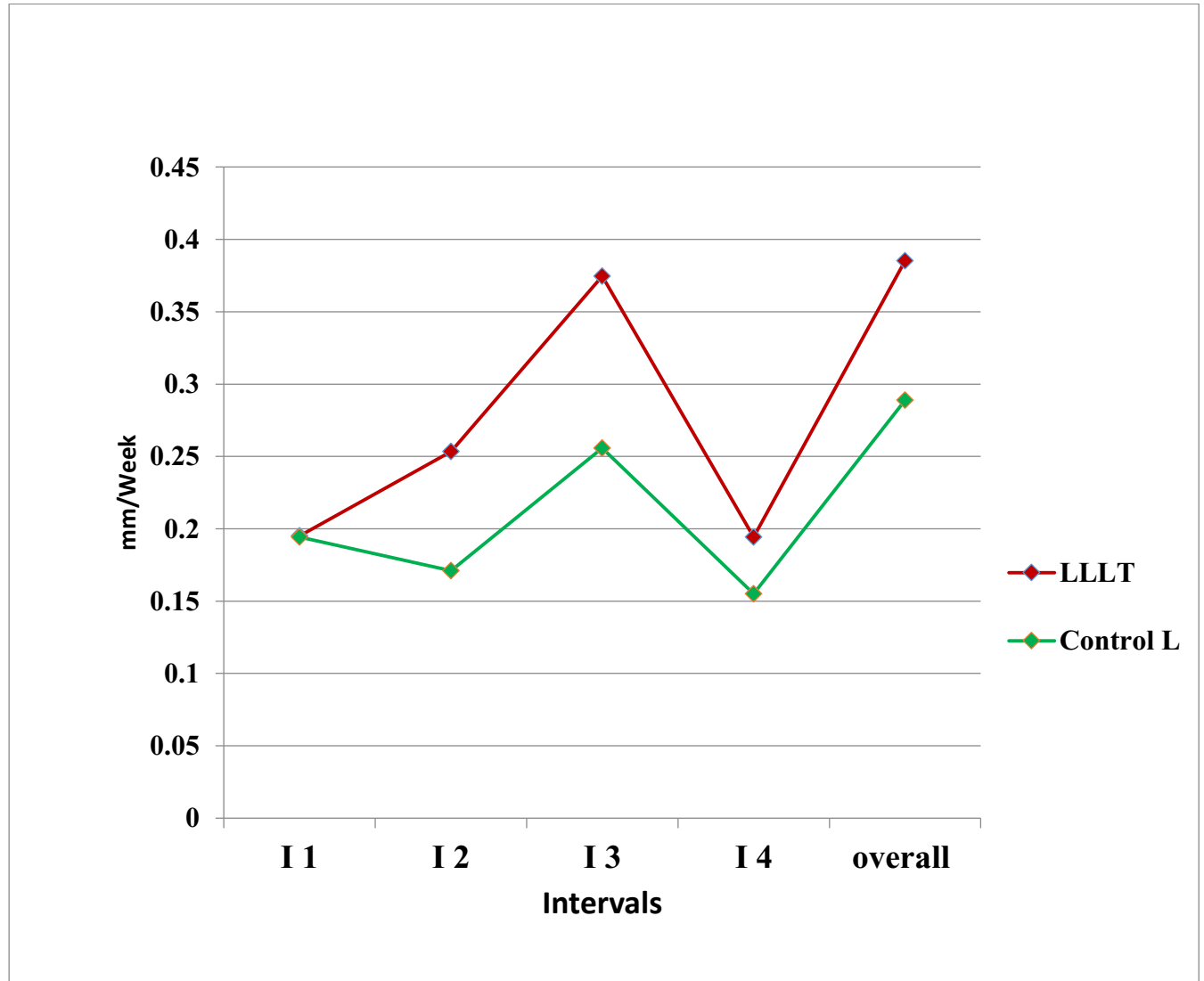
Section 2

The Weekly Rate of Maxillary Canine Retraction

Table 9: Descriptive data of the weekly rate of maxillary canine retraction in group 2 with LLLT side and its Control side at different intervals:

Interval	Side	N	Weekly rate of maxillary canine retraction				
			Median (mm/week)	Minimum (mm/week)	Maximum (mm/week)	Mean	St D
I1	LLLT	8	0.210	0.16	0.23	0.19	0.03
	Control	8	0.207	0.16	0.23	0.19	0.03
I2	LLLT	8	0.247	0.20	0.30	0.25	0.02
	Control	8	0.172	0.15	0.20	0.17	0.01
I3	LLLT	8	0.372	0.36	0.40	0.37	0.30
	Control	8	0.256	0.20	0.31	0.25	0.03
I4	LLLT	8	0.080	0.02	0.94	0.91	0.30
	Control	8	0.132	0.09	0.28	0.15	0.06
I5 (Overall)	LLLT	8	0.387	0.36	0.40	0.38	0.01
	Control	8	0.284	0.27	0.31	0.28	0.01

Section 2

The Weekly Rate of Maxillary Canine Retraction

Figure 47:Line graph showing the weekly rate of maxillary canine retraction in LLLT group and its control group

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Section 2

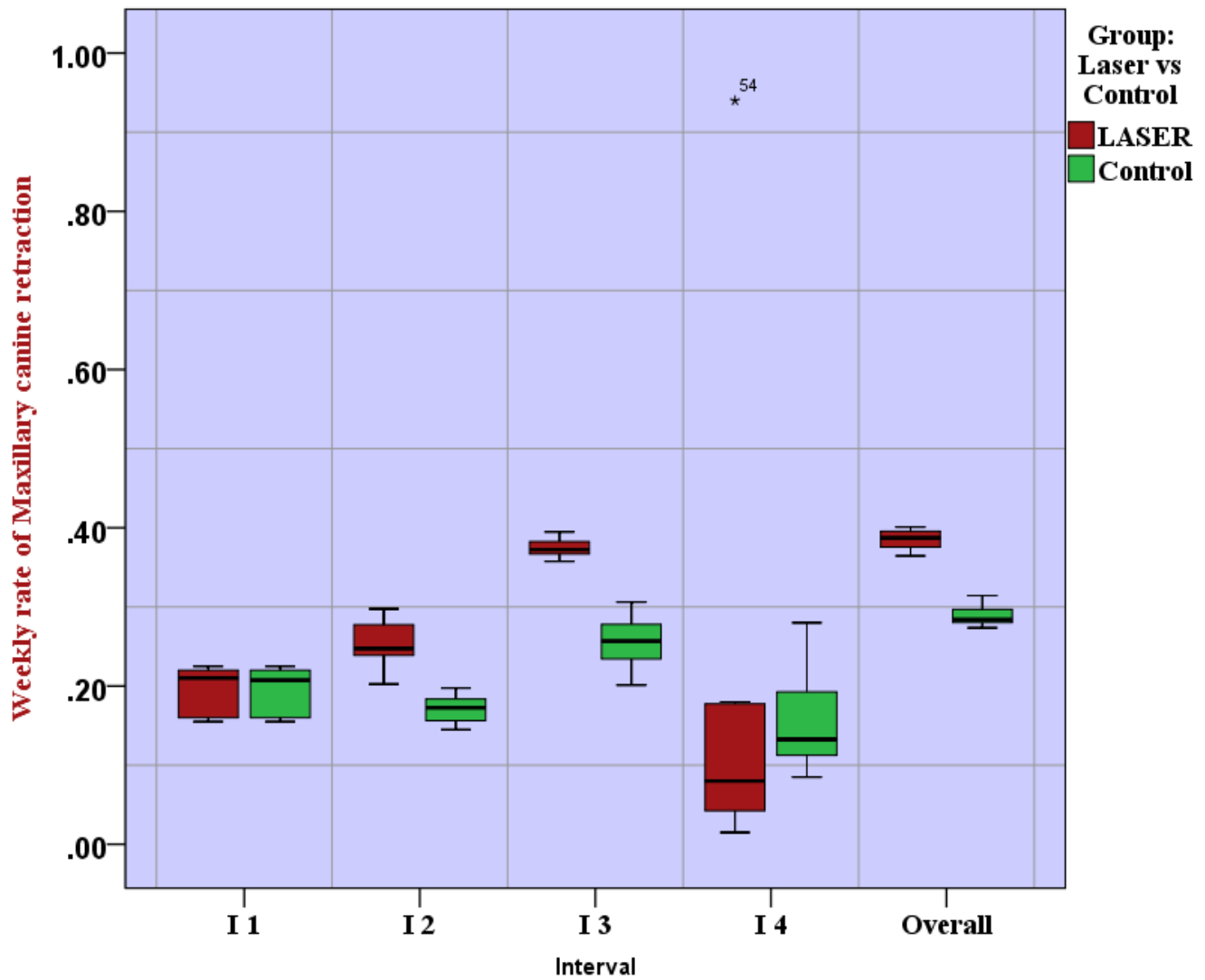## The Weekly Rate of Maxillary Canine Retraction

Figure 48: Boxplot chart showing the mean weekly rate of canine retraction in LLLT and its control groups.

Section 2

The Weekly Rate of Maxillary Canine Retraction

Table 10: Statistical comparison of the difference in weekly rate of maxillary canine retraction in group 1 between LLLT side and its control side at different intervals by Wilcoxon Signed Ranks test

Intervals	Weekly rate of maxillary canine retraction LLLT vs control	
	Z	**Asymp. Sig. (2-tailed)**
I1	-0.577[b]	0.564
I2	-2.521[b]	0.012*
I3	-2.524[b]	0.012*
I4	-0.840[c]	0.401
I5 (Overall)	-2.521[b]	0.012*

a. Values with * are statistically significant with P value <0.05

b. Based on positive ranks.

c. Based on negative ranks.

Section 2

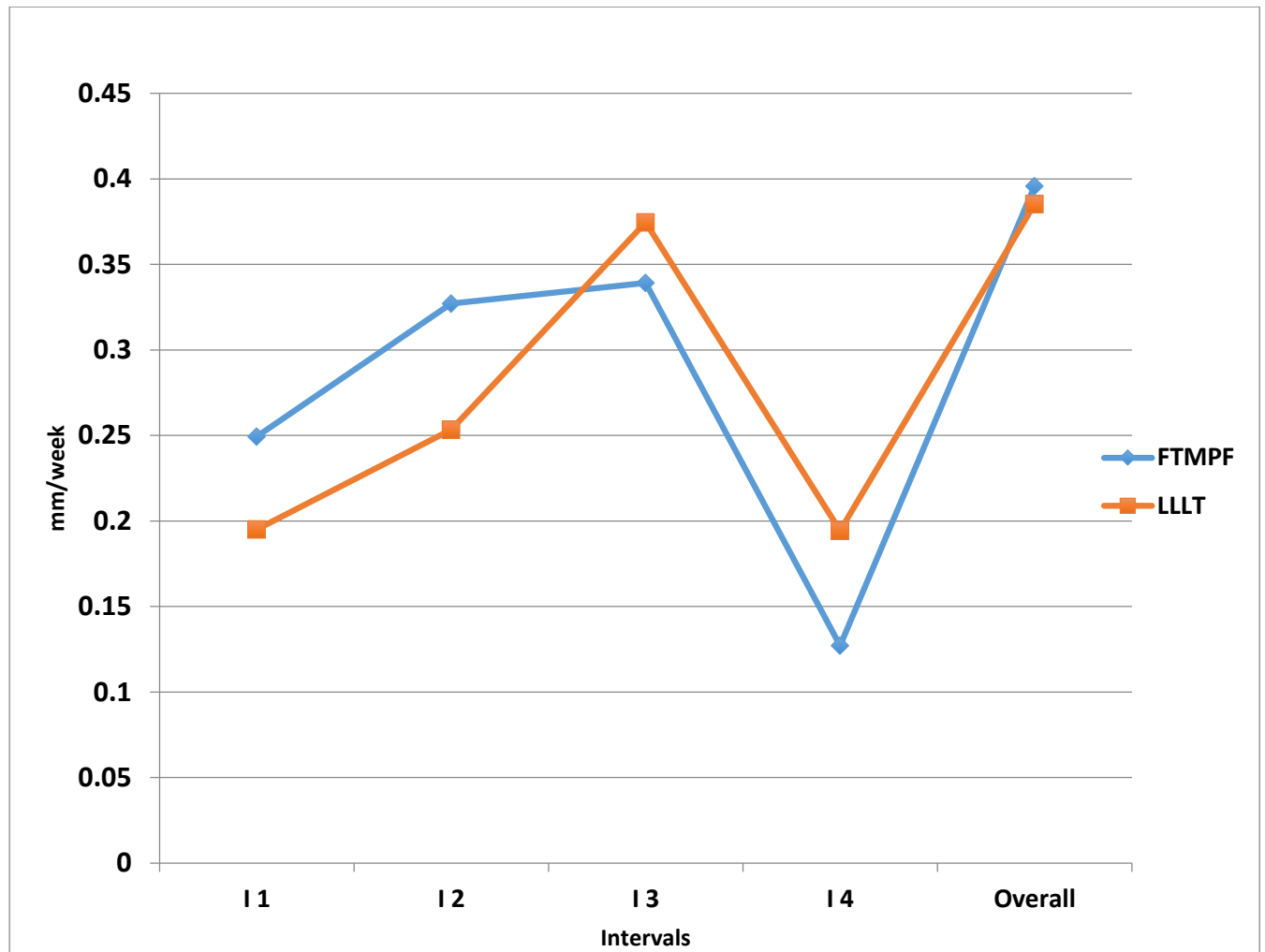## The Weekly Rate of Maxillary Canine Retraction

In Group 1a ; FTMPF versus Group2a; LLLT:

Comparing the difference in weekly rate of maxillary canine retraction between Group 1.a (FTMPF) and Group 2.a(LLLT), was evaluated by Mann-Whitney U test. It is bilateral test and P value of 5% is the limit of statistical significance. Mann-Whitney U test was done to reveal the statistically significant differences between both groups in each interval. The difference between FTMPF and LLLT in the overall weekly rate was statistically non significant. (Table 12)(Figure 49)

Mann-Whitney U test revealed that the differences controls in Group1b and Group 2b in weekly rate of maxillary canine retraction not significant, in order to exclude the cross over reaction. (Table 13)

Section 2

The Weekly Rate of Maxillary Canine Retraction

Figure 49: Line graph showing weekly rate of maxillary canine retraction between group 1a FTMPF and Group 2a LLLT

Section 2

The Weekly Rate of Maxillary Canine Retraction

Table 11: Statistical comparison of the difference in weekly rate of maxillary canine retraction between group 1a FTMPF and group 2a LLLT at different intervals by Mann-Whitney U test

Intervals	Weekly rate of maxillary canine retraction FTMPF vs LLLT				
	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
I1	12.000	48.000	-1.862	0.063	0.072[b]
I2	2.500	38.500	-2.954	0.003	0.001[b] *
I3	5.500	33.500	-2.606	0.009	0.006[b] *
I4	27.000	63.000	-0.116	0.908	0.955[b]
I5 (Overall)	19.000	55.000	-1.042	0.298	0.336[b]

a. Values with * are statistically significant with P value <0.05

b. Grouping Variable: Group

c. Not corrected for ties

Table 13: Statistical comparison of weekly rate of maxillary canine retraction between group 1b and group 2b controls by Mann-Whitney U test

	Weekly rate of maxillary canine retraction FTMPF vs LLLT

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
Weekly rate of maxillary canine retraction FTMPF vs LLLT	19.000	55.000	-1.042	.298	.336[b]

a. Values with * are statistically significant with P value <0.05
b. Grouping Variable: Group c. Not corrected for ties.

Section 3

The Total Number of Weeks to Complete Maxillary Canine Retraction

In Group 1 ; FTMPF group Versus its Control group

The total number of weeks to complete maxillary canine retraction (median, minimum, maximum, mean and standard deviation values) are shown in detail in (Table 14). (Fig.50)

The mean total number of weeks to complete maxillary canine retraction in FTMPF and its Control were 17.14weeks (0.89) and 22.42weeks(0.97) respectively. Comparing the difference in the total number of weeks to complete maxillary canine retraction between Group 1.a (FTMPF) and Group 1.b(its control), was assessed using Wilcoxon Signed Ranks test. It is bilateral test and P value of 5% is the limit of statistical significance. Wilcoxon Signed Ranks test was revealed statistically significant different in the total weeks between FTMPF and its control .(Tables 15)

In Group 2 ; LLLT Group versus its Control group

The total number of weeks to complete maxillary canine retraction (median, minimum, maximum, mean and standard deviation values) are shown in detail in Table (14).(Fig. 51)

The mean total number of weeks to complete maxillary canine retraction in LLLT and its Control were 17.87weeks (0.83) and 22.7weeks (1.28) Comparing the total number of weeks to complete maxillary canine retraction between Group 2.a (LLLT) and Group 2.b (its control), was assessed using Wilcoxon Signed Ranks test. It is bilateral test and P value of 5% is the limit of statistical significance. Wilcoxon Signed Ranks test was revealed statistically significant different in the total weeks between LLLT and its control (Table15)

Section 3

The Total Number of Weeks to Complete Maxillary Canine Retraction

Table 14: Descriptive data of total weeks were needed to complete canine retraction in group 1 (FTMPF and its control) and group 2(LLLT and its control) sides.

Side	N	Total weeks of canine retraction				
		Median (weeks)	Minimum (weeks)	Maximum (weeks)	Mean	St. D
FTMPF	7	17.00	16.00	18.00	17.14	0.89
Control	7	22.00	21.00	24.00	22.42	0.97
LLLT	8	18.00	17.00	19.00	17.87	0.83
Control	8	23.00	21.00	24.00	22.7	1.28

Section 3

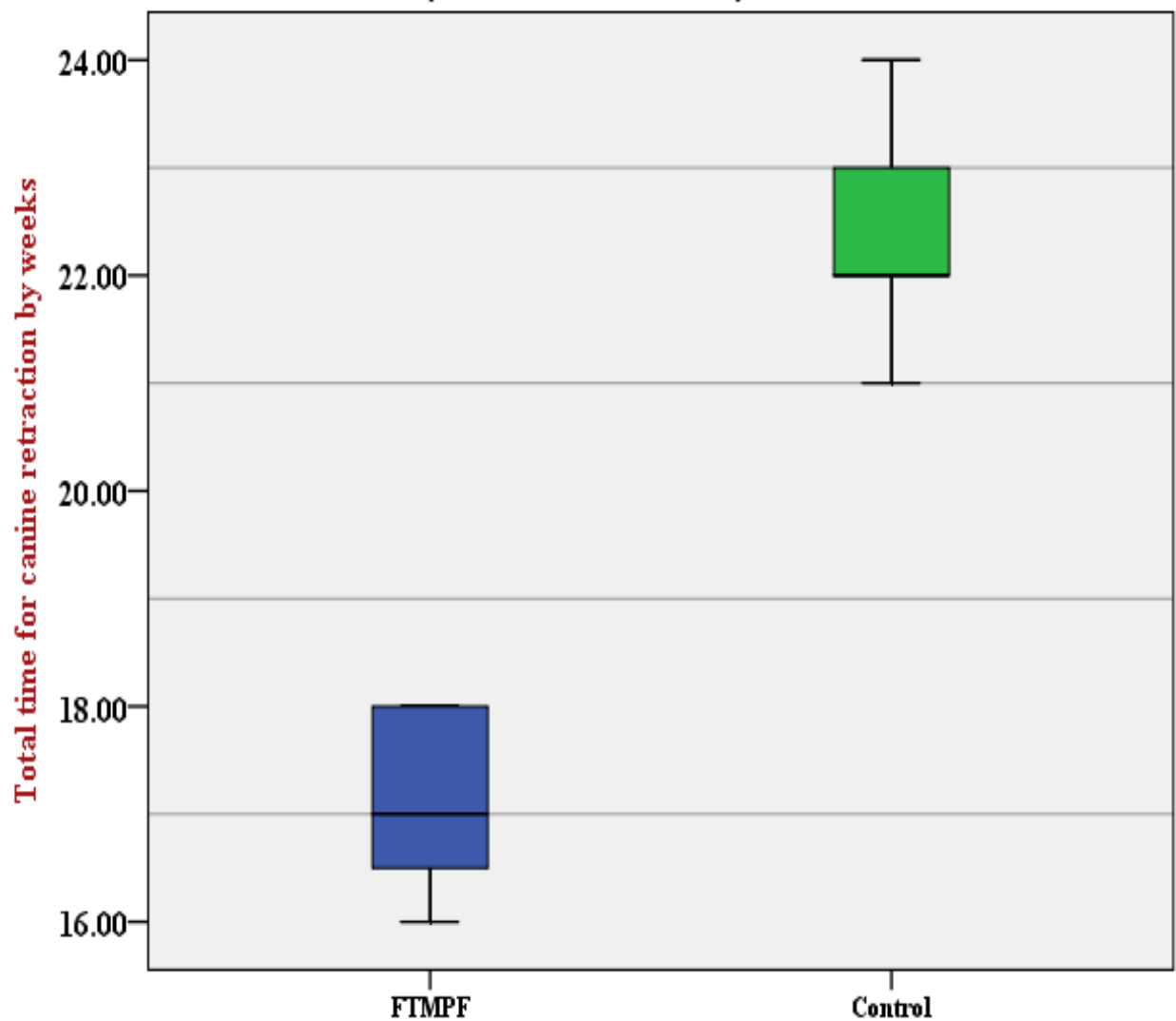**The Total Number of Weeks to Complete Maxillary Canine Retraction**

Figure 50: Box plot chart showing the mean total weeks were needed to complete canine retraction in FTMPF and its control groups

Section 3

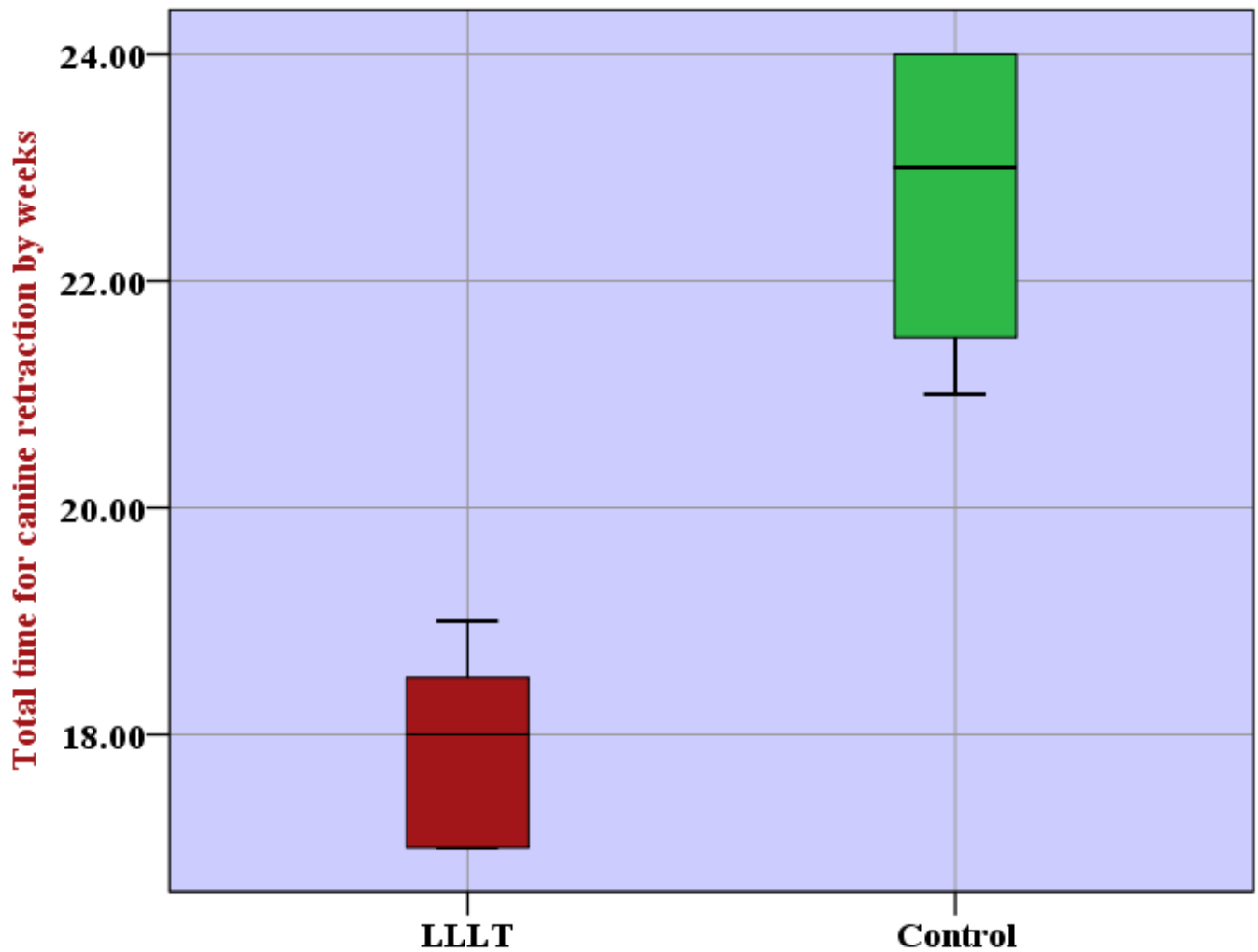## The Total Number of Weeks to Complete Maxillary Canine Retraction

Figure 51:: Box plot chart showing the mean total weeks were needed to complete canine retraction in LLLT and its control.

Section 3

The Total Number of Weeks to Complete Maxillary Canine Retraction

Table 15: Statistical comparison of the difference in total number weeks were needed to complete maxillary canine retraction in group 1 between group 1(FTMPF Side and its Control) and Group2(LLLT and its Control) sides by Wilcoxon Signed Ranks Test.

	Z	Asymp. Sig. (2-tailed)
Total number of weeks of maxillary canine retraction **FTMPF vs Control**	-2.460^{b}	.014*
Total number of weeks of maxillary canine retraction **LLLT vs Control**	-2.549^{b}	0.011*

a. Values with * are statistically significant with P value <0.05

b. Based on positive ranks.

c. Based on negative ranks.

Section 3

The Total Number of Weeks to Complete Maxillary Canine Retraction

In Group 1a ; FTMPF Versus Group2a; LLLT:

Comparing the total number of weeks to complete maxillary canine retraction between Group 1.a (FTMPF) and Group 2.a(LLLT), was evaluated by Mann-Whitney U test. It is a bilateral test and P value of 5% was the limit of statistical significance. Mann-Whitney U test was revealed statistically non significant different in the total weeks between FTMPF and LLLT Groups (Table16) (Fig. 52)

Mann-Whitney U test revealed that the differences controls in Group1b and Group 2b in total number of weeks to complete maxillary canine retraction were not significant, in order to exclude the cross over reaction.(Table 17)

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Section 3

The Total Number of Weeks to Complete Maxillary Canine Retraction

Table16: Statistical comparison of the difference in total number weeks were needed to complete maxillary canine retraction between group 1a FTMPF and group 2a LLLT at different intervals by Mann-Whitney U test.

Total number of weeks of maxillary canine retraction FTMPF vs LLLT	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
	16.500	44.500	-1.404	0.160	0.189[b]

a. Values with * are statistically significant with P value <0.05

b. Grouping Variable: Group

c. Not corrected for ties.

Table 17: Statistical comparison of difference in total number weeks were needed to complete maxillary canine retraction between group 1b and group 2b controls by Mann-Whitney U test

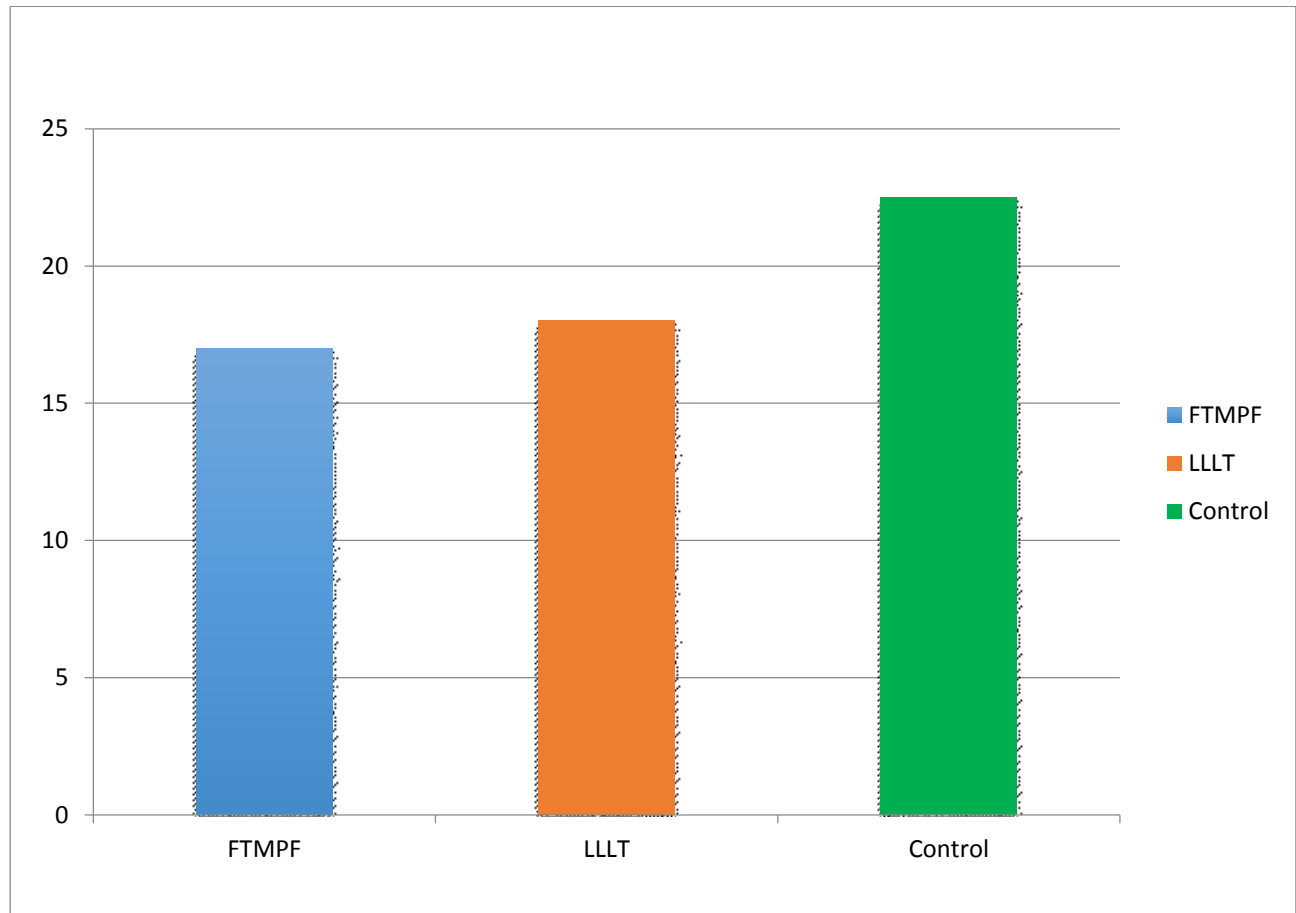|	Mean Distance Moved by Maxillary canine FTMPF vs LLLT				
	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
Total Number Weeks	23.000	51.000	-.597	.550	.613[b]

a. Values with * are statistically significant with P value <0.05

b. Grouping Variable: Group

c. Not corrected for ties.

Section 3

The Total Number of Weeks to Complete Maxillary Canine Retraction

Figure 52: Bar chart showing the mean total weeks were needed to complete canine retraction in FTMPF , LLLT and control Groups

Section 4

The Mesial Movement Amount of First Maxillary Molar After Full Maxillary Canine Retraction

In Group 1 ; FTMPF Group Versus its Control Group

The mesial movement amount of first maxillary molar after full maxillary canine retraction (median, minimum, maximum, mean and standard deviation values) were shown in detail in (Table 18). (Fig. 53)

The mesial movement amount of first maxillary molar after full maxillary canine retraction in FTMPF and its Control were 0.27mm (0.07) and 0.26mm (0.13) respectively. Comparison between both groups, was assessed using Wilcoxon Signed Ranks test. It is bilateral test and a P value of 5% is the limit of statistical significance. Wilcoxon Signed Ranks test revealed no significant difference between FTMPF and its control. (Table 19)

In Group 2 ; LLLT Group Versus its Control Group

The mesial movement amount of first maxillary molar after full maxillary canine retraction (median, minimum, maximum, mean and standard deviation values) were shown in detail in Table (18). (Fig. 54)

The mesial movement amount of first maxillary molar after full maxillary canine retraction in FTMPF and its Control were 0.38mm (0.1) and 0.36mm (0.07) respectively. Comparing between both groups, was assessed using Wilcoxon Signed Ranks test. It is bilateral test and P value of 5% is the limit of statistical significance. Wilcoxon Signed Ranks test revealed that the differences between groups were statistically not significant. (Table 19)

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The Mesial Movement Amount of First Maxillary Molar After Full Maxillary Canine Retraction

Table 18: Descriptive data of the mesial movement amount of first maxillary molar after full maxillary canine retraction in group 1 (FTMPF and its Control) sides and group 2 (LLLT and its Control) sides.

	N	Amount of mesial movement of first maxillary molar				
		Median (mm)	Minimum (mm)	Maximum (mm)	Mean	St.D
FTMPF	7	0.2300	0.06	0.28	0.27	0.07
Control	7	0.3100	0.08	0.47	0.26	0.13
LLLT	8	0.350	0.29	0.60	0.38	0.10
Control	8	0.335	0.31	0.54	0.36	0.07

Table19: Statistical comparison of the difference in the mesial movement amount of first maxillary molar after full maxillary canine retraction in group 1 between FTMPF side and its control sid s and group 2 between LLLT side and its control sides by Wilcoxon Signed Ranks Test.

	Z	Asymp. Sig. (2-tailed)
Amount of mesial movement of first maxillary molar FTMPF vs Control	-1.355[b]	0.176
Amount of mesial movement of first maxillary molar LLLT vs Control	-.639[b]	0.523

a. Values with * are statistically significant with P value <0.05
b. Based on positive ranks.

c. Based on negative ranks.

Section 4

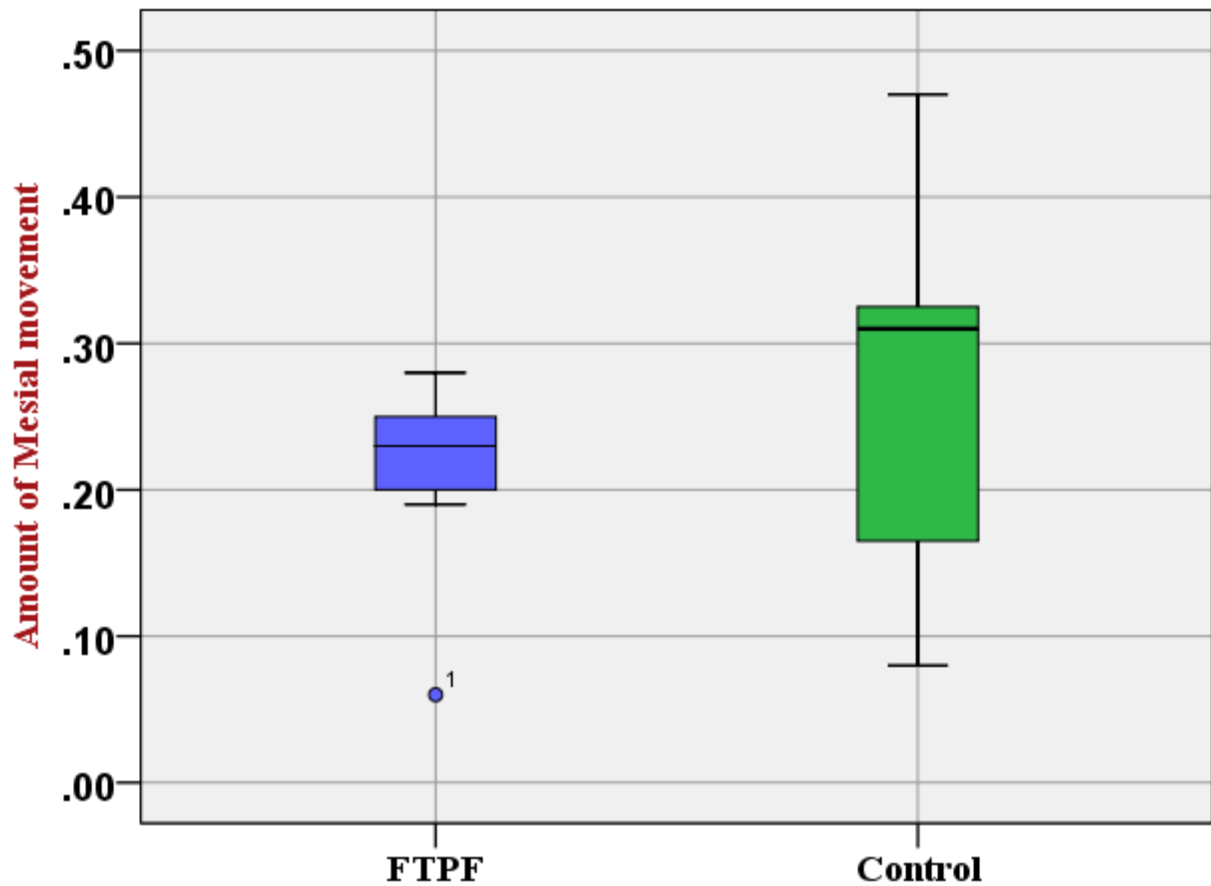## The Mesial Movement Amount of First Maxillary Molar After Full Maxillary Canine Retraction

Figure 53: Boxplot chart showing the mean amount of masial movement of first maxillary molar in FTMPF and its control group.

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The Mesial Movement Amount of First Maxillary Molar After Full Maxillary Canine Retraction
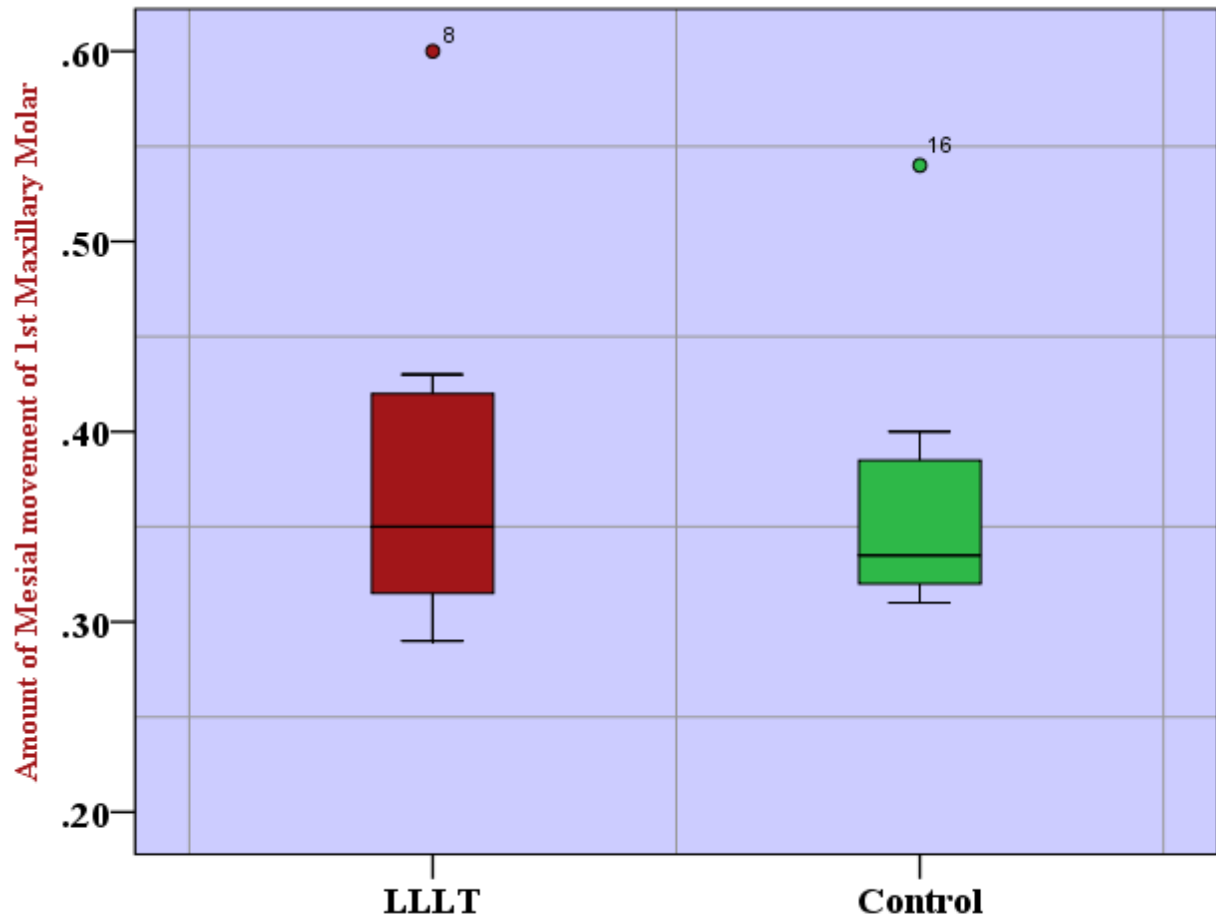

Figure 54: Boxplot chart showing the mean amount of masial movement of first maxillary molar in LLLT and its control group.

Section 4

The Mesial Movement Amount of First Maxillary Molar After Full Maxillary Canine Retraction

In group 1a ; FTMPF versus group 2a; LLLT:

Comparing the mesial movement amount of first maxillary molar after full maxillary canine retraction between Group 1.a (FTMPF) and Group 2.a(LLLT), was evaluated by Mann-Whitney U test. It is bilateral test and P value of 5% is the limit of statistical significance. Mann-Whitney U test revealed that the differences between groups were statistically significant .(Tables 20)(Fig. 55)

Mann-Whitney U test revealed that the differences between controls in Group1b and Group 2b in mesial movement amount of first maxillary molar after full maxillary canine retraction not significant, in order to exclude the cross over reaction.(Table 21)

Table20: Statistical comparison of the difference in the mesial movement amount of first maxillary molar after full maxillary canine retraction between group 1a FTMPF and group 2a LLLT by Mann-Whitney U test.

Amount of mesial movement of first maxillary molar FTMPF vs LLLT	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
	.000	28.000	-3.243	0.001 *	0.000[b]

a. Values with * are statistically significant with P value <0.05
b. Grouping Variable: Group c. Not corrected for ties.

Section 4

The Mesial Movement Amount of First Maxillary Molar After Full Maxillary Canine Retraction

Table21: Statistical comparison of difference in mesial movement amount of first maxillary molar after full maxillary canine retraction between group 1b and group 2b controls by Mann-Whitney U test
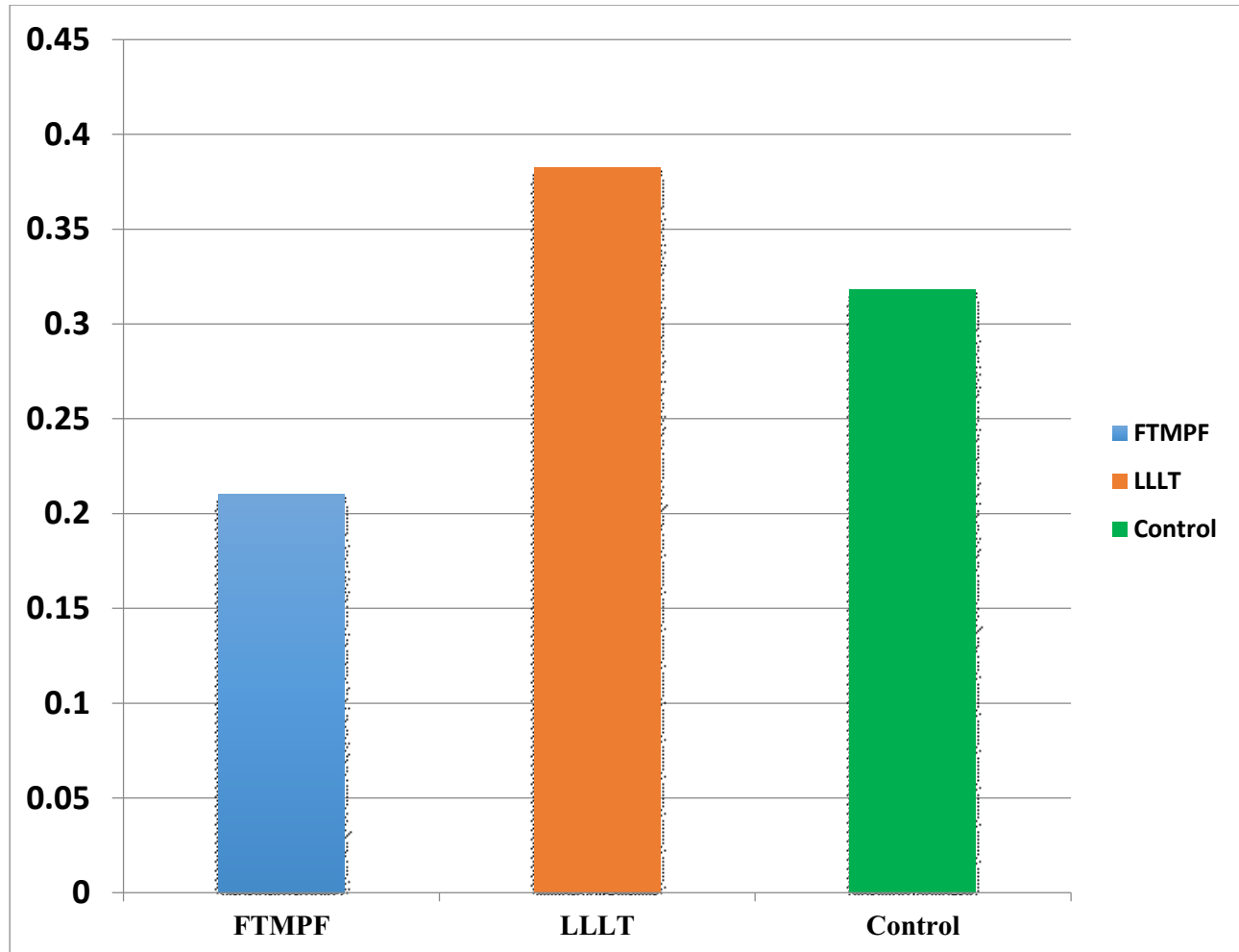
	Amount of mesial movement of first maxillary molar				
	Mann-Whitney U	**Wilcoxon W**	**Z**	**Asymp. Sig. (2-tailed)**	**Exact Sig. [2*(1-tailed Sig.)]**
Amount of mesial movement of first maxillary molar	13.500	41.500	-1.696	.090	.094[b]

a. Values with * are statistically significant with P value <0.05
b. Grouping Variable: Group   c. Not corrected for ties.

Section 4

The Mesial Movement Amount of First Maxillary Molar After Full Maxillary Canine Retraction

Figure 55: Bar chart showing the amount of mesial movement of first maxillary molar after full canine retraction in FTMPF , LLLT and control groups.

Section 5

The Difference in the Amount Change in Average Maxillary Canine Periodontal Pocket Depth After Its Full Retraction

In Group 1 ; FTMPF group versus its Control group

The difference in the amount change in average maxillary canine periodontal pocket depth after full maxillary canine retraction (median, minimum, maximum, mean and standard deviation values) were shown in detail in (Table 22). (Fig.56)

The mean amount change in average maxillary canine periodontal pocket depth after full maxillary canine retraction in FTMPF and its control were 0.13mm (0.20), 0.11mm (0.35) respectively. Comparing the difference between both groups was assessed using Wilcoxon Signed Ranks test. It is bilateral test and P value of 5% is the limit of statistical significance. It revealed that the difference between groups was statistically significant . (Table 23)

In Group 2 ; LLLT group versus its Control group

The difference in the amount change in average maxillary canine periodontal pocket depth after its full retraction between (median, minimum, maximum, mean and standard deviation values) were shown in detail in (Table 22). (Fig. 57) The mean amount change in average maxillary canine periodontal pocket depth after full maxillary canine retraction in LLLT and its control 0.08mm (0.27), 0.06mm (0.28) respectively. Comparison of the difference between both groups was assessed using Wilcoxon Signed Ranks test. It is bilateral test and a P value of 5% is the limit of statistical significance. It revealed that the differences between groups were statistically not significant. (Table 23)

Section 5

The Difference in the Amount Change in Average Maxillary Canine Periodontal Pocket Depth after Its Full Retraction

Table22: Descriptive data of the amount change in average maxillary canine periodontal pocket depth after full maxillary canine retraction in group 1 (FTMPF and its Control) and group 2 (LLLT and its Control) Sides

	N	Change in average maxillary canine periodontal pocket depth				
		Median (mm)	Minimum (mm)	Maximum(mm)	Mean	St.D
FTMPF	7	0.100	-0.09	0.50	0.13	0.20
Control	7	-0.200	-0.90	0.23	0.11	0.35
LLLT	8	.0350	-0.20	0.72	0.08	0.27
Control	8	.0000	-0.20	0.75	0.06	0.28

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Section 5

The Difference in the Amount Change in Average Maxillary Canine Periodontal Pocket Depth After Its Full Retraction
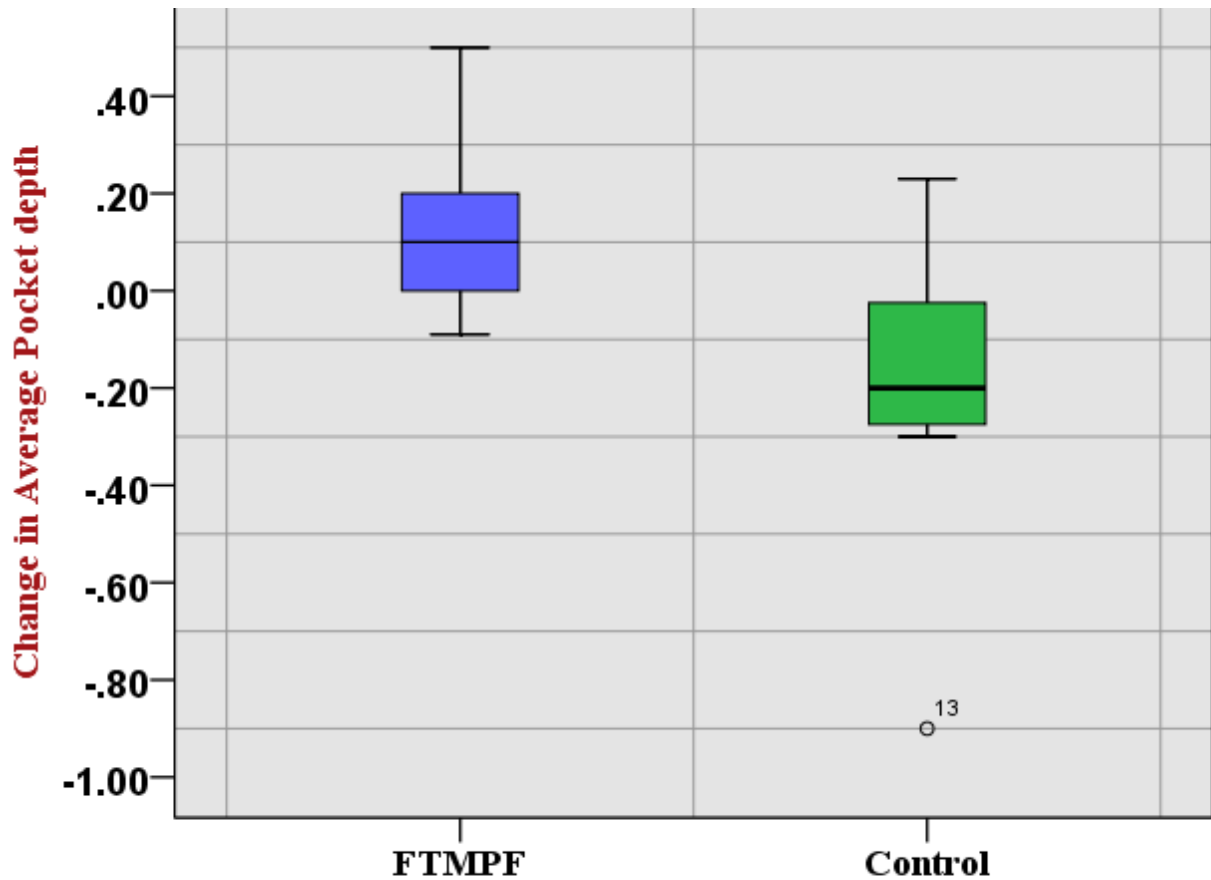

Figure 16:Boxplot chart showing the amount change in average pocket depth after full canine retraction in FTMPF and its control sides.

Section 5

The Difference in the Amount Change in Average Maxillary Canine Periodontal Pocket Depth After Its Full Retraction
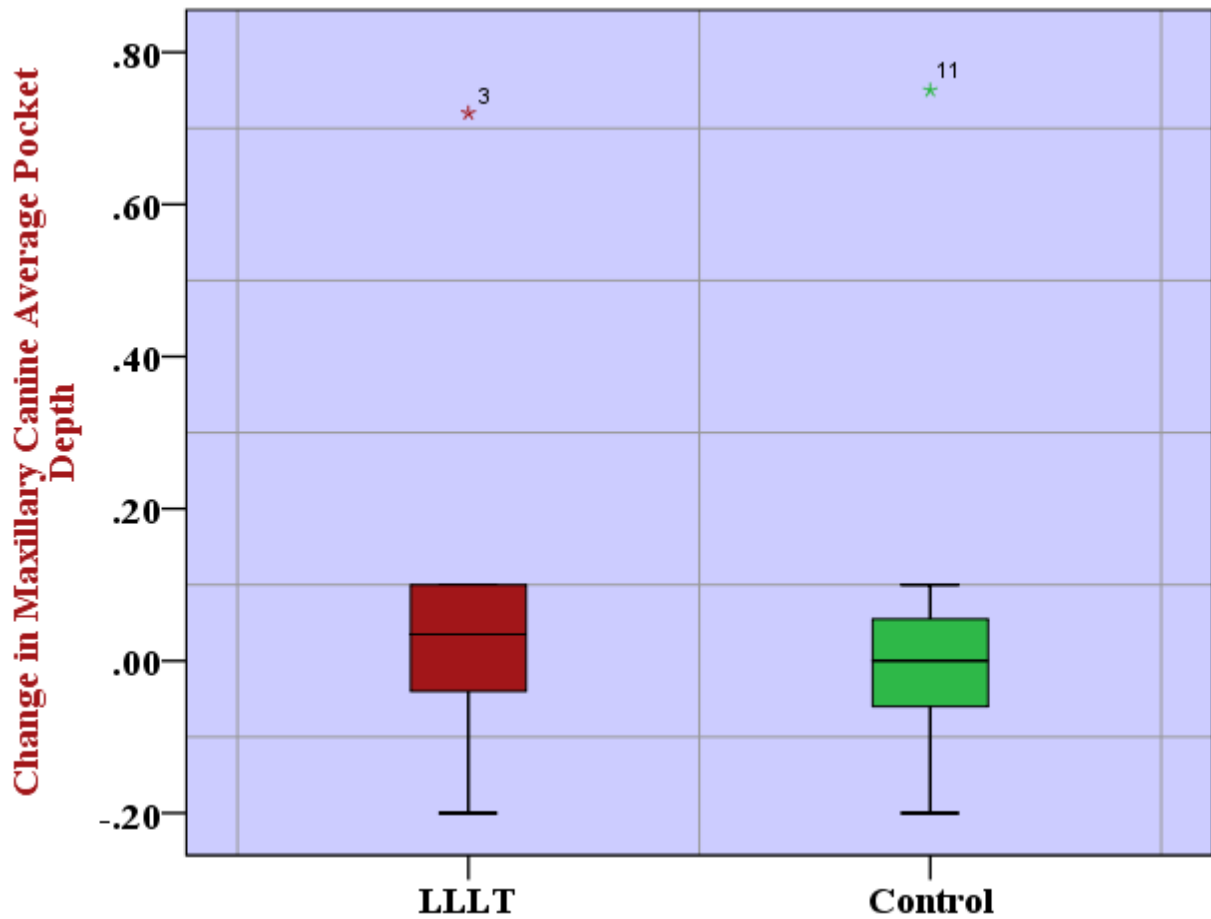

Figure 57:Boxplot chart showing the amount change in average pocket depth after full canine retraction in LLLT and its control sides.

Section 5

The Difference in the Amount Change in Average Maxillary Canine Periodontal Pocket Depth After Its Full Retraction

Table23:Statistical comparison of the difference in the amount change in average maxillary canine periodontal pocket depth after full retraction in group 1 between FTMPF side and its control and group 2 LLLT Side and its control side by Wilcoxon Signed Ranks Test.

	Z	Asymp. Sig. (2-tailed)
Change in average maxillary canine periodontal pocket depth **FTPF vs Control**	-2.371^{b}	.018*
Change in average maxillary canine periodontal pocket depth **LLLT vs Control**	$-.350^{b}$	0.726

a. Values with * are statistically significant with P value <0.05

b. Based on positive ranks.

c. Based on negative ranks.

Section 5

The Difference in the Amount Change in Average Maxillary Canine Periodontal Pocket Depth After Its Full Retraction

In group 1a ; FTMPF versus group2a; LLLT:

Comparing the difference in the amount change in average maxillary canine periodontal pocket depth after its full retraction between Group 1.a (FTMPF) and Group 2.a (LLLT), was evaluated by Mann-Whitney U test. It is bilateral test and P value of 5% is the limit of statistical significance. Mann-Whitney U test was done to reveal that the differences between groups were statistically not significant, (Table 24) (Fig. 58)

Mann-Whitney U test revealed that the differences controls in Group1b and Group 2b not significant, in order to exclude the cross over reaction.(Table 25)

Table24: Statistical comparison of the difference in the amount change in average maxillary canine periodontal pocket depth after full retraction between group 1a FTMPF and Group 2a LLLT at different intervals by Mann-Whitney U test.

Change in average maxillary canine periodontal pocket depth FTMPF vs LLLT	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
	24.000	60.000	-0.469	0.639	0.694[b]

a. Values with * are statistically significant with P value <0.05
b. Grouping Variable: Group
c. Not corrected for ties.

Section 5

The Difference in the Amount Change in Average Maxillary Canine Periodontal Pocket Depth after Its Full Retraction

Table25: Statistical comparison of difference amount change in average maxillary canine periodontal pocket depth after full retraction between group 1b and group 2b controls by Mann-Whitney U test

	Amount change in average maxillary canine periodontal pocket depth after full retraction				
	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
Maxillary Canine Periodontal Pocket Depth controls	15.000	43.000	-1.509	0.131	0.152[b]

a. Values with * are statistically significant with P value <0.05

b. Grouping Variable: Group   c. Not corrected for ties.

Section 5

The Difference in the Amount Change in Average Maxillary Canine Periodontal Pocket Depth After Its Full Retraction
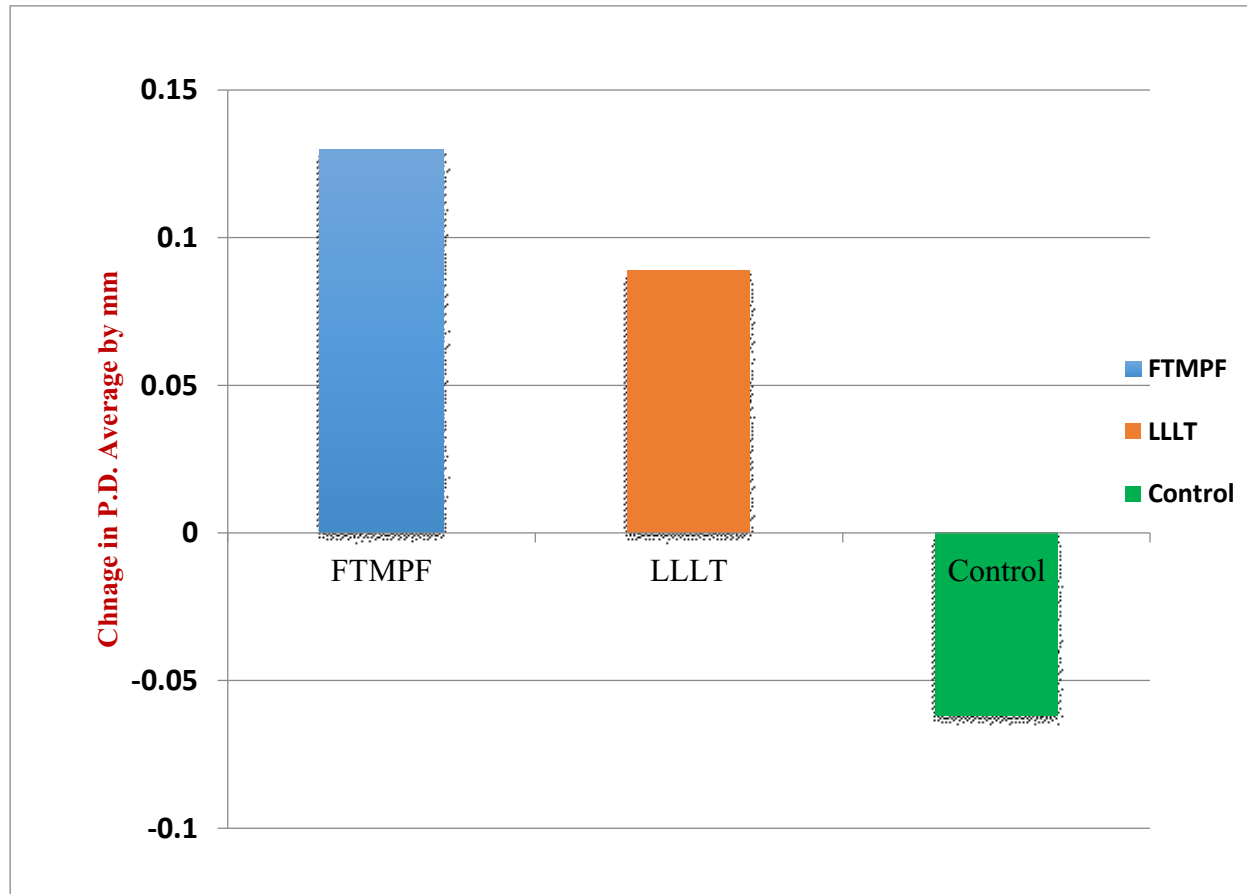

Figure 58: Bar chart showing the amount change in average periodontal pocket depth in FTMPF, LLLT and control sides.

Summary Results

FTMPF vs Control: Significant difference was found in:

- Mean distance moved by maxillary canine at 2 and 6 weeks.
- Weekly rate of maxillary canine retraction at 2 and 6 weeks.
- Weekly rate of maxillary canine retraction (overall).
- Total time needed for canine retraction by weeks.
- Change in pocket depth average after full canine retraction.

LLLT vs Control: Significant difference was found in:

- Mean distance moved by maxillary canine at 6 and 14 weeks.
- Mean overall distance moved by maxillary canine.
- Weekly rate of maxillary canine retraction at 6 and 14 weeks.
- Weekly overall rate of maxillary canine retraction.
- Total time needed for canine retraction by weeks.

FTMPF vs LLLT: significant difference was found in:
- Mean distance moved by maxillary canine at 6 and 14 weeks
- Weekly rate of maxillary canine retraction at 6 and 14 weeks
- Amount of mesial movement of first maxillary molar after full canine retraction.

Controls:
   There was no significant difference between any of the measured data between both groups controls.