

Effectiveness of Combined Scolio-Trainer™ Therapy and Over-Corrective Nighttime Bracing in the Management of Scoliosis

Non-Surgical Scoliosis Correction Using the Scolio-Trainer® System

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Executive Summary

113 patients (ages 8–83) treated over 12–24 months.

Results:

Upper Thoracic: 31% improvement
Lower Thoracic: 44% improvement
Lumbar: 26% improvement

63% improved, 37% no change

Best outcome: Full correction

Conclusion

Structured non-surgical care may improve scoliosis in a majority of patients.

METHODOLOGY

Statistical Analysis

Descriptive Statistics

Patient demographics and baseline characteristics were summarized using frequencies and percentages for categorical variables, including age group (child <18 years, adult ≥18 years), gender, care compliance, and treatment modality (brace, scoliosis table, or both).

Continuous variables, such as age in years, start Cobb angles of thoracic 1, thoracic 2, and lumbar curves, and the in-brace Cobb angles, were presented as mean and standard deviation (SD) or median and interquartile range (IQR), as necessary.

Cobb Angle Change Calculation

The change in Cobb angle was calculated as the difference between the baseline (Start Cobb) and follow-up measurements. If a 2-year follow-up measurement was available, it was used; otherwise, the 1-year follow-up value was used. Positive values indicate improvement in spinal curvature.

Inferential Statistics

The Shapiro-Wilk test was used to test the normality of continuous data. The data was normally distributed hence parametric tests were used. Cobb angle and percent improvement between age groups (child under 18 years vs adult over 18 years) were compared using Independent Sample t-tests and changes over time within patients were compared using Paired Sample t-tests (comparing start Cobb, in-brace Cobb, 1-year, and 2-year Cobb angles).

Further, linear mixed-effects models (LMMs) were used to control repeated measurements and evaluate time points (start, in-brace X-ray, 1-year, 2-year) and age groups (child vs adult) influences on the changes in Cobb angle.

Additionally, subgroup analyses were performed separately for children and adults to assess within-group longitudinal changes in thoracic and lumbar Cobb angles.

Significance Level

A p-value of less than 0.05 was considered statistically significant.

Software

All statistical analyses were performed using IBM SPSS Statistics version 27.0.1.

RESULTS

Baseline Characteristics and Treatment Outcomes of Patients Undergoing Scoliosis Management

The analysis included 113 patients, and the mean age was 32.27 ± 21.82 years (**Figure 1**). Out of them 38.1% were children (<18 years) and 61.9% were adults, where most of them were females (81.4%) (**Figure 2**). Most of the patients (71.7%) adhered to therapy. Baseline Cobb angles were similar between regions of the spine, with a mean thoracic and lumbar curve approximately 30 degrees, which is moderate in severity of scoliosis. The in-brace radiographs revealed a significant immediate correction, especially in the thoracic and lumbar areas, indicating successful mechanical reduction with therapy.

At follow-up, the mean Cobb angles demonstrated a slow decrease over time, with further improvement observed at 1 year and maintained or slightly improved at 2 years, although fewer patients had long-term follow-up data. Mean change in Cobb angle showed a decrease in about 4-6 degrees across spinal regions, which is clinically significant. The percentage improvement analyses revealed an average correction of 30.6% of the thoracic curves and 25.8% of the lumbar curves (**Figure 5**), with more improvement in thoracic 2 curves, but with less sample size.

Most patients (91.2%) were treated using a combination of brace and table therapy. Regarding the outcomes, among patients who completed care (N = 48), 62.5% showed improvement in their Cobb angle, while 37.5% had no change. Overall, 30.0% of patients stopped care, and 26.4% were still actively undergoing treatment at the time of analysis (**Figure 3, 4**). In general, the results indicate that the given method of treatment can deliver significant improvements in Cobb angle in patients who adhere to it and follow-up.

Table 1: Baseline Characteristics and Treatment Outcomes of Patients Undergoing Scoliosis Management (N=113)

		Mean \pm SD	Median (IQR)	N	%
Age Years		32.27 ± 21.82	23.00 (14.00-47.00)		
Age Group	Child (<18)			43	38.1%
	Adult (\geq 18)			70	61.9%
Gender	Female			92	81.4%
	Male			21	18.6%
Care Compliant	No			32	28.3%
	Yes			81	71.7%
Start Cobb	Thoracic 1 (N=109)	30.68 ± 15.52	28.00 (20.00-39.00)		
	Thoracic 2 (N=10)	29.60 ± 17.10	33.00 (14.00-45.00)		
	Lumber (N=98)	29.74 ± 13.82	27.00 (20.00-38.00)		
In Brace X-Ray	Thoracic 1 (N=36)	13.19 ± 14.04	13.00 (0.00-18.00)		
	Thoracic 2 (N=1)	$27.00 \pm .$	27.00 (27.00-27.00)		
	Lumber (N=34)	9.62 ± 13.06	6.00 (0.00-12.00)		

1 Yr. Cobb	Thoracic 1 (N=49)	25.45 ± 12.11	27.00 (16.00-32.00)		
	Thoracic 2 (N=6)	26.33 ± 12.80	29.00 (14.00-35.00)		
	Lumber (N=40)	22.20 ± 10.72	21.50 (16.50-28.00)		
2 Yr. Cobb	Thoracic 1 (N=10)	23.70 ± 10.25	23.50 (18.00-30.00)		
	Thoracic 2 (N=1)	33.00 ± .	33.00 (33.00-33.00)		
	Lumber (N=8)	20.88 ± 12.67	19.00 (11.50-26.00)		
Cobb Angle Change	Thoracic 1 (N=49)	-4.92 ± 5.48	-4.00 (-8.00-0.00)		
	Thoracic 2 (N=6)	-6.00 ± 6.48	-5.50 (-8.00-0.00)		
	Lumber (N=40)	-4.28 ± 5.49	-3.50 (-8.00-0.00)		
Brace/Table	Both			103	91.2%
	Brace			4	3.5%
	Table			6	5.3%
Results	Currently in care			29	26.4%
	Based on Patients who complete care (N=48)	Improvement		30	62.5%
		No Change		18	37.5%
	Stopped care			33	30.0%
Cobb Angle Improvement %	Thoracic 1 (N=28)	30.57 ± 16.18	28.00 (19.50-35.50)		
	Thoracic 2 (N=3)	44.00 ± 18.68	47.00 (24.00-61.00)		
	Lumber (N=22)	25.82 ± 16.60	23.00 (13.00-38.00)		

Figure 1. Distribution of Patient Age in Years (Age in Years)

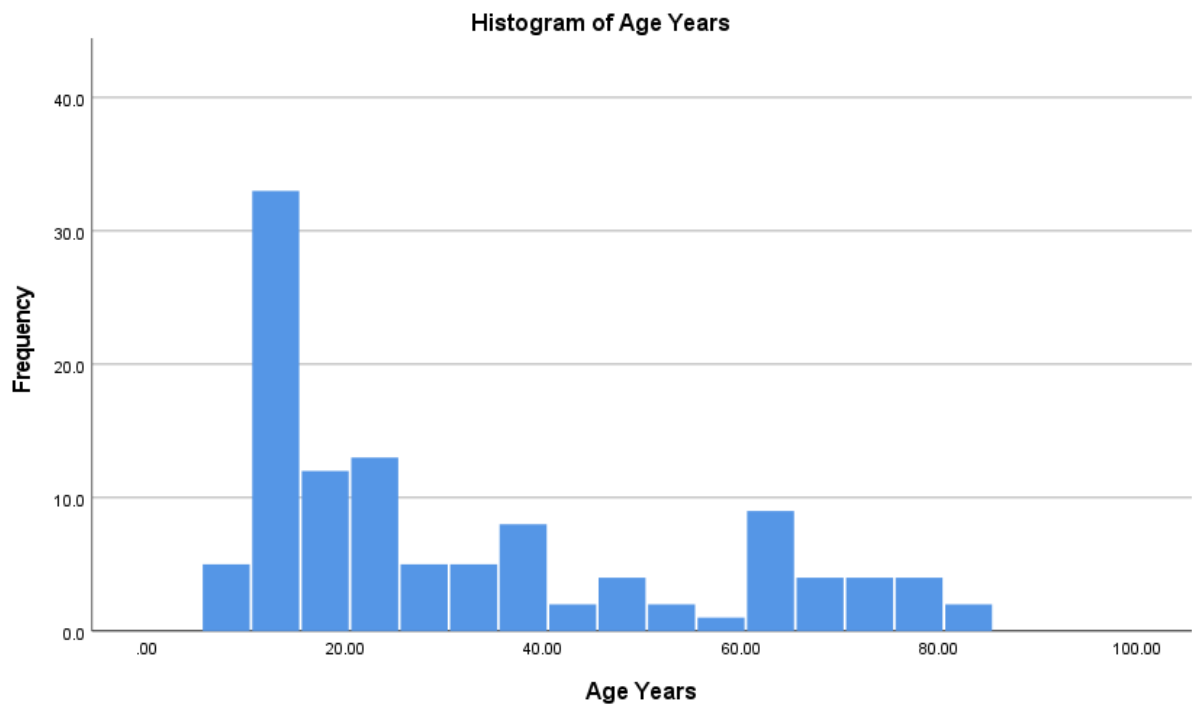


Figure 2. Gender Distribution of Study Participants (% , N)

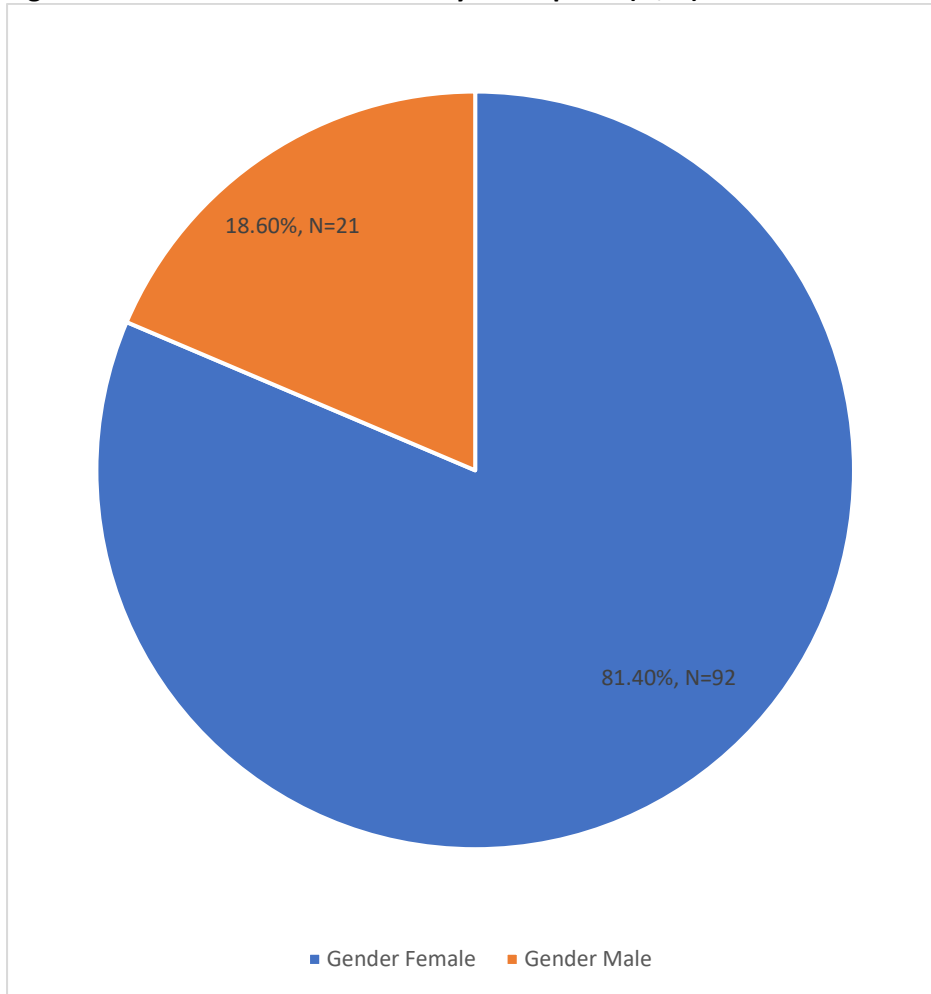


Figure 3. Patient Outcomes Following Scoliosis Treatment (%)

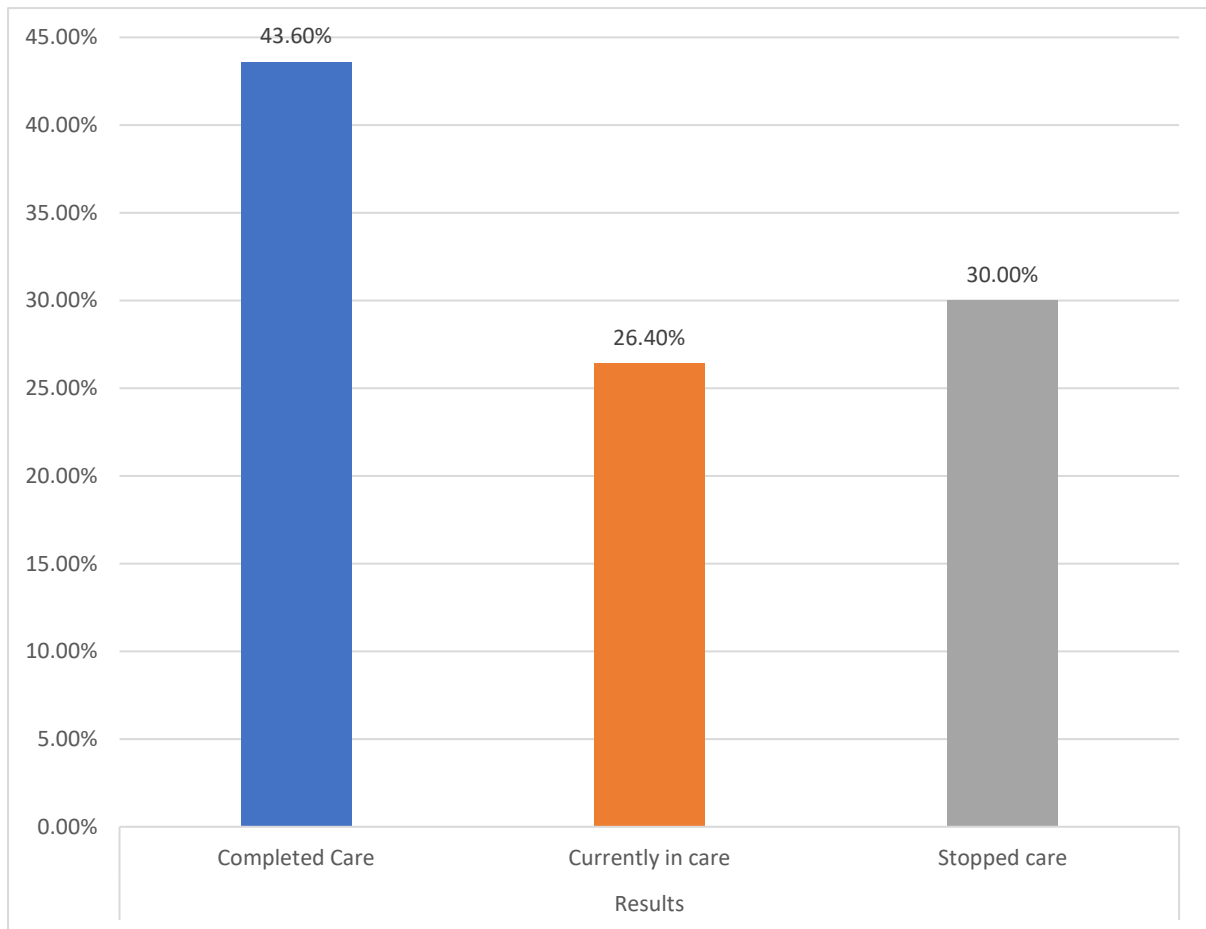


Figure 4. Treatment Outcomes Among Patients Who Completed Care (%)

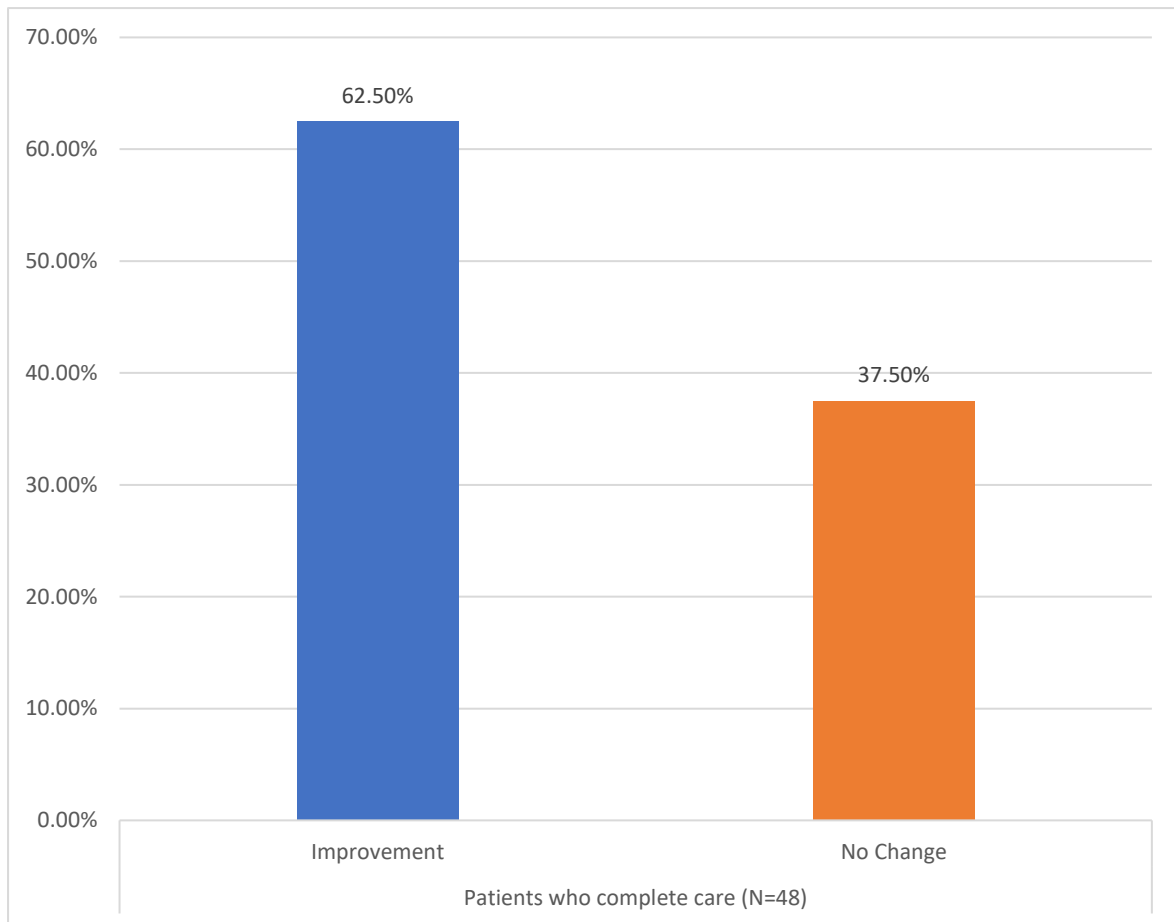
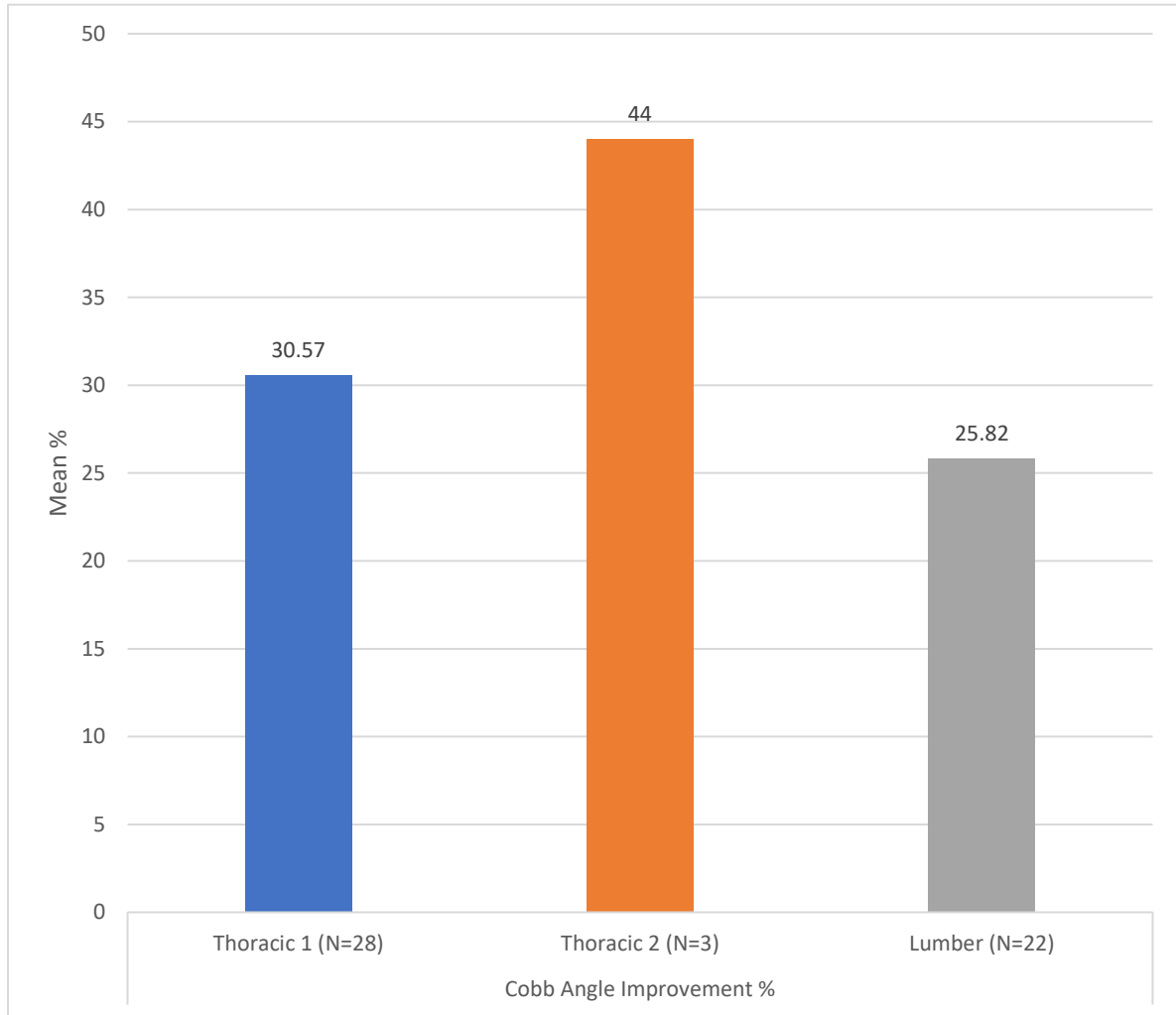


Figure 5. Percentage Overall Improvement in Cobb Angle by Curve Type (%)



Comparison of Cobb Angle Change and Percentage Improvement Between Children and Adults

A comparative analysis of the treatment outcome between children (<18 years) and adult (≥18 years) showed that the patterns of improvement are similar in both populations. In thoracic curves (Thoracic 1), the average decrease in Cobb angle was -4.83 ± 6.39 degrees in children and -4.97 ± 5.00 degrees in adults and there was no significant difference between the groups ($p = 0.939$). Similarly, the lumbar curve changes had a mean of -5.50 ± 4.91 degrees in children as compared to -3.62 ± 5.76 degrees in adults with no significant difference ($p = 0.285$). Percentage improvement in Cobb angle was comparable between age groups, with thoracic curve improvements of $30.22\% \pm 22.62$ in children and $30.74\% \pm 12.85$ in adults ($p = 0.951$), and lumbar improvements of $25.38\% \pm 16.92$ and $26.07\% \pm 17.05$, respectively ($p = 0.927$). The secondary thoracic curve data were scarce and were available on adults only, making it impossible to compare them meaningfully. In general, these results suggest that the treatment method produces the same rates of improvement in children and adults, and no statistically significant differences between the groups have been found.

Table 2. Comparison of Cobb Angle Change and Percentage Improvement Between Children and Adults

		Age Group				P value [†]
		Child (<18 Years)		Adult (≥18 Years)		
		Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	
Cobb Angle Change	Thoracic 1 (N=49)	-4.83 ± 6.39	-2.50 (-9.00-0.00)	-4.97 ± 5.00	-4.00 (-8.00-0.00)	0.939
	Thoracic 2 (N=6)	. ± .	. (-.-)	-6.00 ± 6.48	-5.50 (-8.00-0.00)	-
	Lumber (N=40)	-5.50 ± 4.91	-6.00 (-9.00--1.00)	-3.62 ± 5.76	-2.50 (-7.00-0.00)	0.285
Cobb Angle Improvement %	Thoracic 1 (N=28)	30.22 ± 22.62	20.00 (17.00-42.00)	30.74 ± 12.85	28.00 (21.00-35.00)	0.951
	Thoracic 2 (N=3)	. ± .	. (-.-)	44.00 ± 18.68	47.00 (24.00-61.00)	-
	Lumber (N=22)	25.38 ± 16.92	22.50 (14.50-38.50)	26.07 ± 17.05	23.00 (13.00-32.00)	0.927

[†]Independent Sample t test

* $p < 0.05$, Significant

Longitudinal Changes in Thoracic Cobb Angle and Linear Mixed Model Analysis Across Time Points

The longitudinal Thoracic 1 Cobb analysis showed significant variations at various time points of treatment. It was found that the Cobb angle decreased significantly between the baseline (31.08 ± 14.96) and in-brace X-ray (13.19 ± 14.04) and this difference was statistically significant ($p < 0.001$), which demonstrates that immediate correction with bracing was strong. Nonetheless, the difference between in-brace and the 1-year follow-up (9.76 ± 8.82 vs. 23.06 ± 12.45 , $p < 0.001$) indicated that, at least partially, the correction was lost. Between 1-year and 2-year follow-up, a modest, non-significant improvement was observed ($27.11 \pm 8.99^\circ$ vs. $24.33 \pm 10.67^\circ$, $p = 0.081$). The linear mixed-effects model further supported these findings, showing that the brace X-ray time point was associated with a significant decrease in Cobb angle relative to baseline (estimate: -17.50 , 95% CI -22.99 to -12.01 , $p < 0.001$), while 1-year follow-up still showed a smaller but significant reduction relative to baseline (estimate: -5.30 , 95% CI -9.82 to -0.78 , $p = 0.022$). No significant difference was observed at the 2-year time point (estimate: -6.44 , 95% CI -14.13 to 1.25 , $p = 0.094$). Age group (child vs. adult) did not significantly affect Cobb angle changes ($p = 0.187$). Overall, these results suggest that bracing provides substantial immediate correction, partial regression occurs within the first year, and treatment effects tend to stabilize by the second year, with comparable outcomes across age groups (**Figure 6**)

Table 3. Longitudinal Changes in Thoracic Cobb Angle and Linear Mixed Model Analysis Across Time Points

	N	Mean \pm SD	Mean \pm SD	P value ^t
Thoracic 1	36	Start	Brace X-ray	<0.001*
		31.0833 \pm 14.96162	13.1944 \pm 14.04242	
	17	Brace X-ray	1 Year	<0.001*
		9.7647 \pm 8.82135	23.0588 \pm 12.44724	
	9	1 Year	2 Year	0.081
		27.1111 \pm 8.99228	24.3333 \pm 10.66536	

^tPaired Sample t test

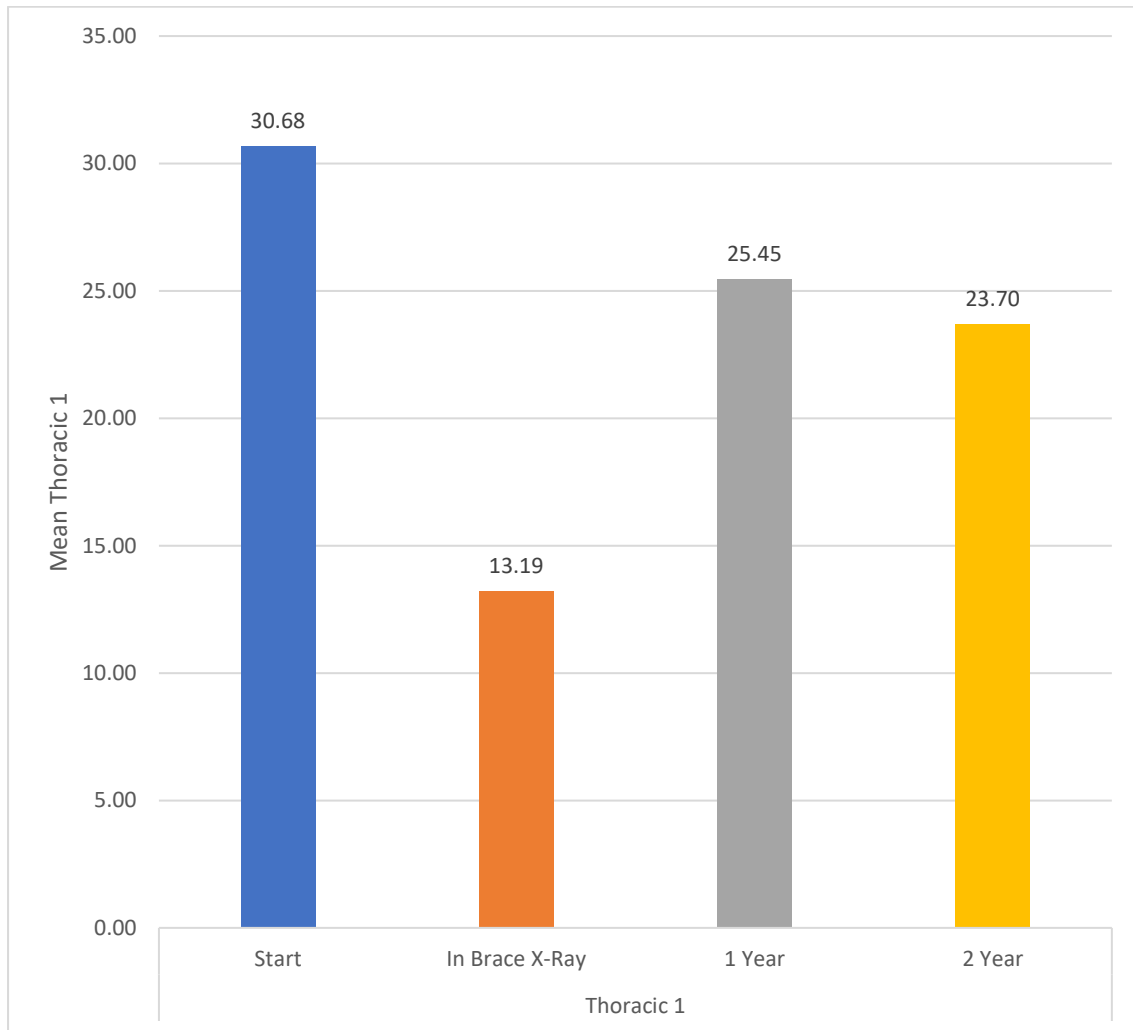
* $p < 0.05$, Significant

Estimates of Fixed Effects								
Parameter		Std. Error	df	t	Estimate	95% Confidence Interval		P value
						Lower Bound	Upper Bound	
Intercept		1.913778	162.696	15.197	29.083636	25.304589	32.862682	<0.001*
Age Group	Child	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Adult	1.987848	182.480	1.325	2.634602	-1.287520	6.556724	0.187
Time Point	Start	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Brace X-ray	2.748315	65.996	-6.367	-	-	-	<0.001*
	1 Year	2.283430	116.316	-2.322	-5.301445	-9.823936	-7.78953	0.022*
	2 Year	3.572368	13.491	-1.802	-6.437476	-	1.251676	0.094
						14.126629		

a. Dependent Variable: Thoracic 1.

b. This parameter is set to zero because it is redundant.

Figure 6. Mean Thoracic Cobb Angle Changes Across Treatment Time Points (Cobb Angle in Degrees)



Longitudinal Changes in Lumbar Cobb Angle and Linear Mixed Model Analysis Across Time Points

Longitudinal evaluation of lumbar Cobb angle showed that there were significant changes throughout the treatment period. The difference between the baseline ($30.58 \pm 14.20^\circ$) and in-brace X-ray ($10.55 \pm 13.32^\circ$; $p < 0.001$) showed a significant and statistically significant decrease, which suggests that there is strong immediate correction in bracing. Nevertheless, the difference in Cobb angle between in-brace and 1-year follow-up ($7.50 \pm 7.28^\circ$ vs. $21.21 \pm 12.24^\circ$, $p < 0.001$) indicated a partial loss of initial correction. Between 1-year and 2-year follow-up, a modest, non-significant improvement was observed ($25.29 \pm 10.86^\circ$ vs. $22.86 \pm 12.27^\circ$, $p = 0.277$). The linear mixed-effects model showed that the brace X-ray time point was significantly associated with a decrease in Cobb angle relative to baseline (estimate: -20.07, 95% CI -25.30 to -14.84, $p < 0.001$), and the 1-year follow-up also demonstrated a significant reduction (estimate: -7.55, 95% CI -11.94 to -3.16, $p < 0.001$). In contrast, the 2-year follow-up did not differ significantly from baseline (estimate: -8.44, 95% CI -19.57 to 2.70, $p = 0.119$). Age group (child vs. adult) did not significantly affect lumbar Cobb angle changes ($p = 0.371$). Overall, these results indicate that bracing provides substantial short-term correction in lumbar curves, some regression occurs over time, and stabilization is achieved by the second year, with comparable outcomes across age groups (**Figure 7**)

Table 4. Longitudinal Changes in Lumbar Cobb Angle and Linear Mixed Model Analysis Across Time Points

	N	Mean \pm SD	Mean \pm SD	P value ^t
Lumber	31	Start	Brace X-ray	<0.001*
		30.5806 \pm 14.19806	10.5484 \pm 13.32376	
	14	Brace X-ray	1 Year	<0.001*
		7.5000 \pm 7.28275	21.2143 \pm 12.23600	
	7	1 Year	2 Year	0.277
		25.2857 \pm 10.85840	22.8571 \pm 12.26687	

^tPaired Sample t test

* $p < 0.05$, Significant

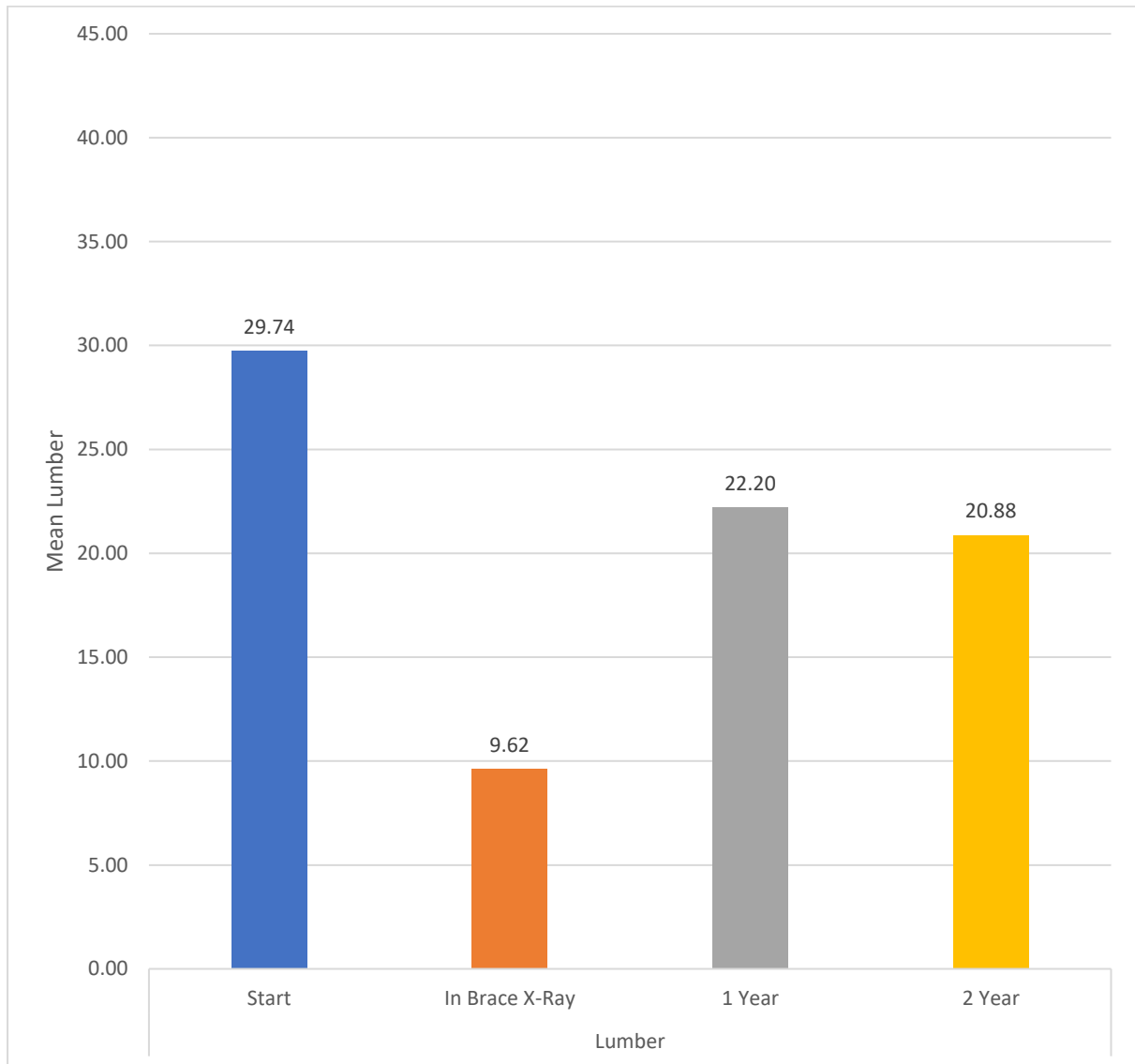
Estimates of Fixed Effects

Parameter	Std. Error	df	t	Estimate	95% Confidence Interval		P value	
					Lower Bound	Upper Bound		
Intercept	1.851696	147.036	15.473	28.652091	24.992716	32.311467	<0.001*	
Age Group	Child	Ref	Ref	Ref	Ref	Ref	Ref	
	Adult	1.956952	167.152	.897	1.755656	-2.107871	5.619184	0.371
Time Point	Start	Ref	Ref	Ref	Ref	Ref	Ref	
	Brace X-ray	2.614893	60.116	-7.674	-	-	-	<0.001*
	1 Year	2.209398	90.652	-3.417	-7.549377	-	-3.160451	<0.001*
	2 Year	4.861079	8.325	-1.735	-8.435463	-	2.698488	0.119

a. Dependent Variable: Lumber.

b. This parameter is set to zero because it is redundant.

Figure 7. Mean Lumbar Cobb Angle Changes Across Treatment Time Points (Cobb Angle in Degrees)



Sub Group Analysis Age <18 Years (N=43)

Baseline Characteristics, Treatment Outcomes, and Cobb Angle Changes in Patients Aged <18 Years

A total of 43 pediatric patients (<18 years) were included, with a mean age of 13.44 ± 2.12 years (**Figure 8**). The majority were female (86.0%) (**Figure 9**), and 72.1% were compliant with treatment. At baseline, mean Cobb angles were $29.65 \pm 16.65^\circ$ for thoracic curves and $28.22 \pm 11.68^\circ$ for lumbar curves, indicating moderate curve severity. In-brace X-rays demonstrated substantial immediate correction, with thoracic and lumbar angles reduced to $9.57 \pm 8.22^\circ$ and $5.50 \pm 6.36^\circ$, respectively, among those assessed. At 1-year follow-up, mean Cobb angles were $24.22 \pm 12.68^\circ$ (thoracic) and $22.80 \pm 12.37^\circ$ (lumbar), with further stabilization observed at 2 years in a smaller subset of patients. The mean reduction in Cobb angle was $-4.83 \pm 6.39^\circ$ for thoracic curves and $-5.50 \pm 4.91^\circ$ for lumbar curves. Most patients (86.0%) were treated with a combination of brace and table therapy. Among patients who completed care (N=15), 60.0% showed improvement, while 40.0% had no change (**Figure 11**). Additionally, 31.7% of patients discontinued care and 31.7% were still undergoing treatment (**Figure 10**). The percentage improvement in Cobb angle averaged 30.22% for thoracic curves and 25.38% for lumbar curves (**Figure 12**). Overall, these findings suggest that the treatment approach provides meaningful correction in pediatric patients, with strong immediate in-brace effects and moderate sustained improvements over time, although treatment adherence and completion remain important factors influencing outcomes.

Table 5. Baseline Characteristics, Treatment Outcomes, and Cobb Angle Changes in Patients Aged <18 Years

		Mean \pm SD	Median (IQR)	N	%
Age Years		13.44 ± 2.12	14.00 (12.00-15.00)		
Gender	Female			37	86.0%
	Male			6	14.0%
Care Compliant	No			12	27.9%
	Yes			31	72.1%
Start Cobb	Thoracic 1 (N=43)	29.65 ± 16.65	26.00 (17.00-36.00)		
	Thoracic 2 (N=1)	$7.00 \pm .$	7.00 (7.00-7.00)		
	Lumber (N=37)	28.22 ± 11.68	25.00 (20.00-36.00)		
In Brace X-Ray	Thoracic 1 (N=14)	9.57 ± 8.22	10.00 (0.00-18.00)		
	Lumber (N=14)	5.50 ± 6.36	6.00 (0.00-8.00)		
1 Yr. Cobb	Thoracic 1 (N=18)	24.22 ± 12.68	21.50 (19.00-30.00)		
	Lumber (N=15)	22.80 ± 12.37	21.00 (17.00-30.00)		
2 Yr. Cobb	Thoracic 1 (N=6)	22.50 ± 12.74	20.50 (18.00-30.00)		
	Lumber (N=5)	24.60 ± 14.05	19.00 (19.00-28.00)		
Cobb Angle Change	Thoracic 1 (N=18)	-4.83 ± 6.39	-2.50 (-9.00-0.00)		

	Lumber (N=14)	-5.50 ± 4.91	-6.00 (-9.00-- 1.00)		
Brace/Table	Both			37	86.0%
	Brace			2	4.7%
	Table			4	9.3%
Results	Currently in care			13	31.7%
	Based on Patients who complete care (N=15)	Improvement		9	60.0%
		No Change		6	40.0%
	Stopped care			13	31.7%
Cobb Angle Improvement %	Thoracic 1 (N=9)	30.22 ± 22.62	20.00 (17.00- 42.00)		
	Lumber (N=8)	25.38 ± 16.92	22.50 (14.50- 38.50)		

Figure 8. Distribution of Patient Age in Years (Age in Years) - Age < 18 (Child)

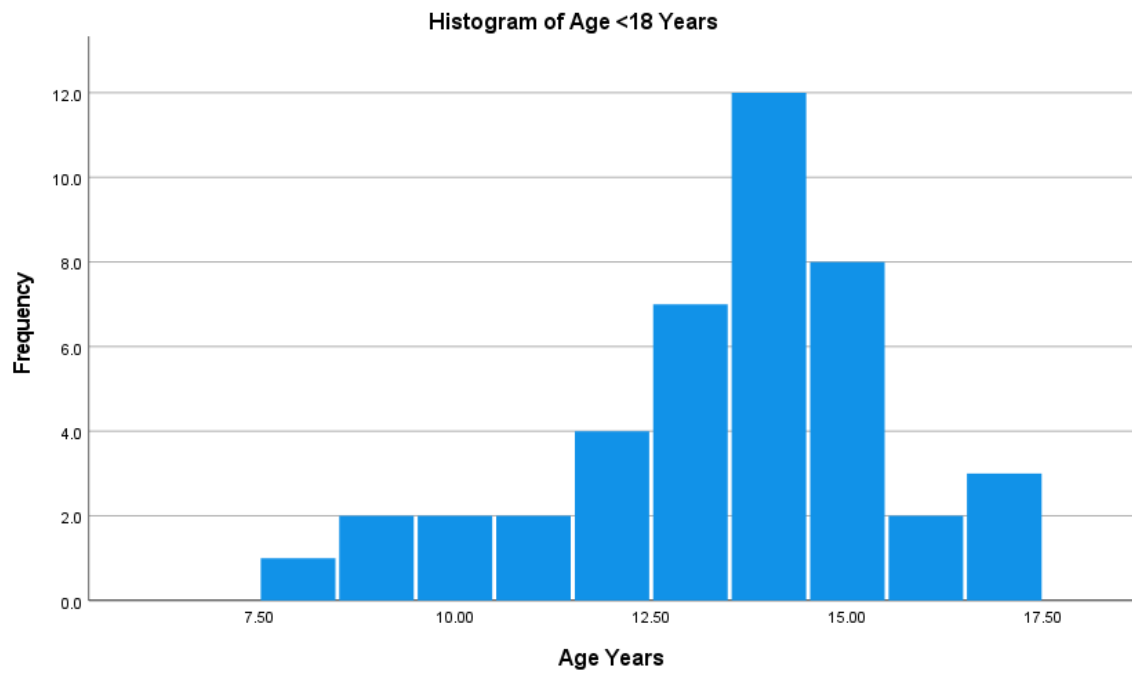


Figure 9. Gender Distribution of Study Participants (% , N) - Age < 18 (Child)

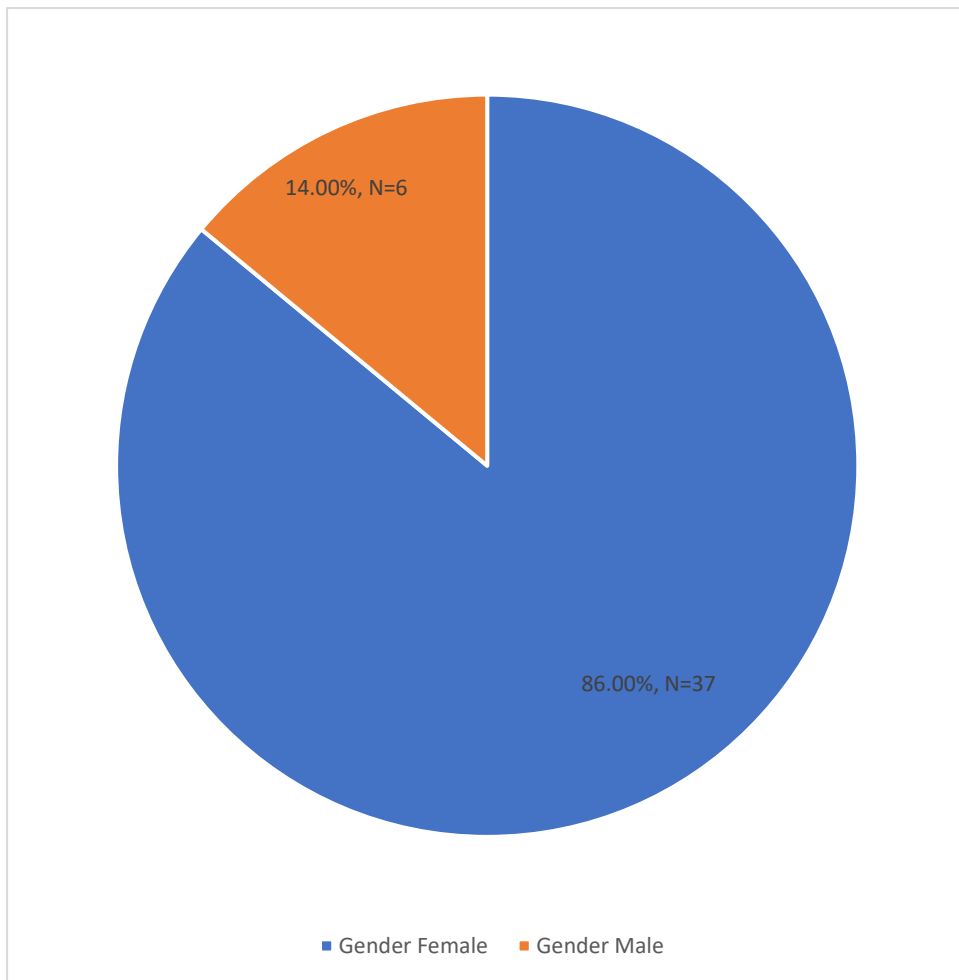


Figure 10. Patient Outcomes Following Scoliosis Treatment (%) - Age < 18 (Child)

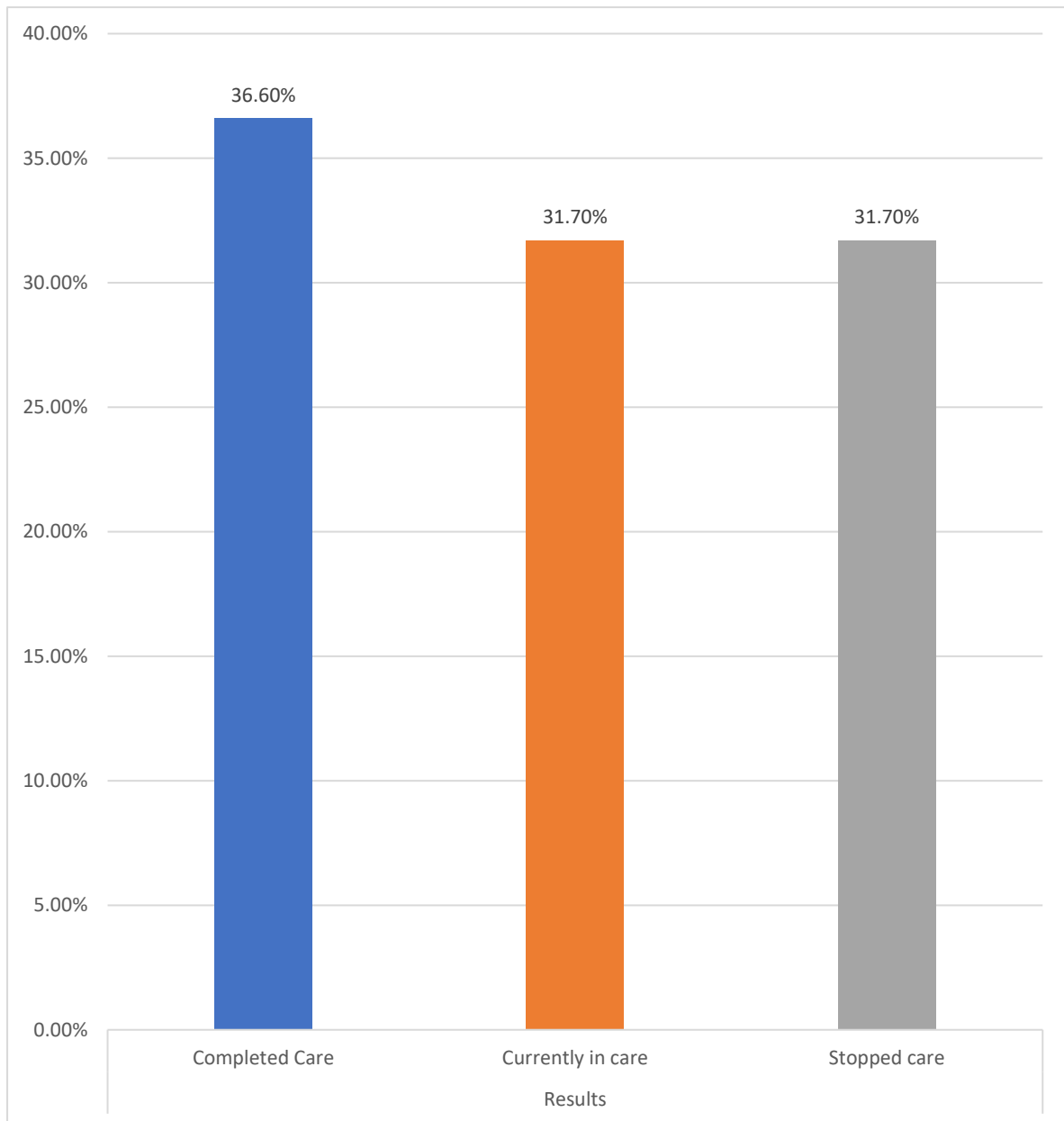


Figure 11. Treatment Outcomes Among Patients Who Completed Care (%) - Age < 18 (Child)

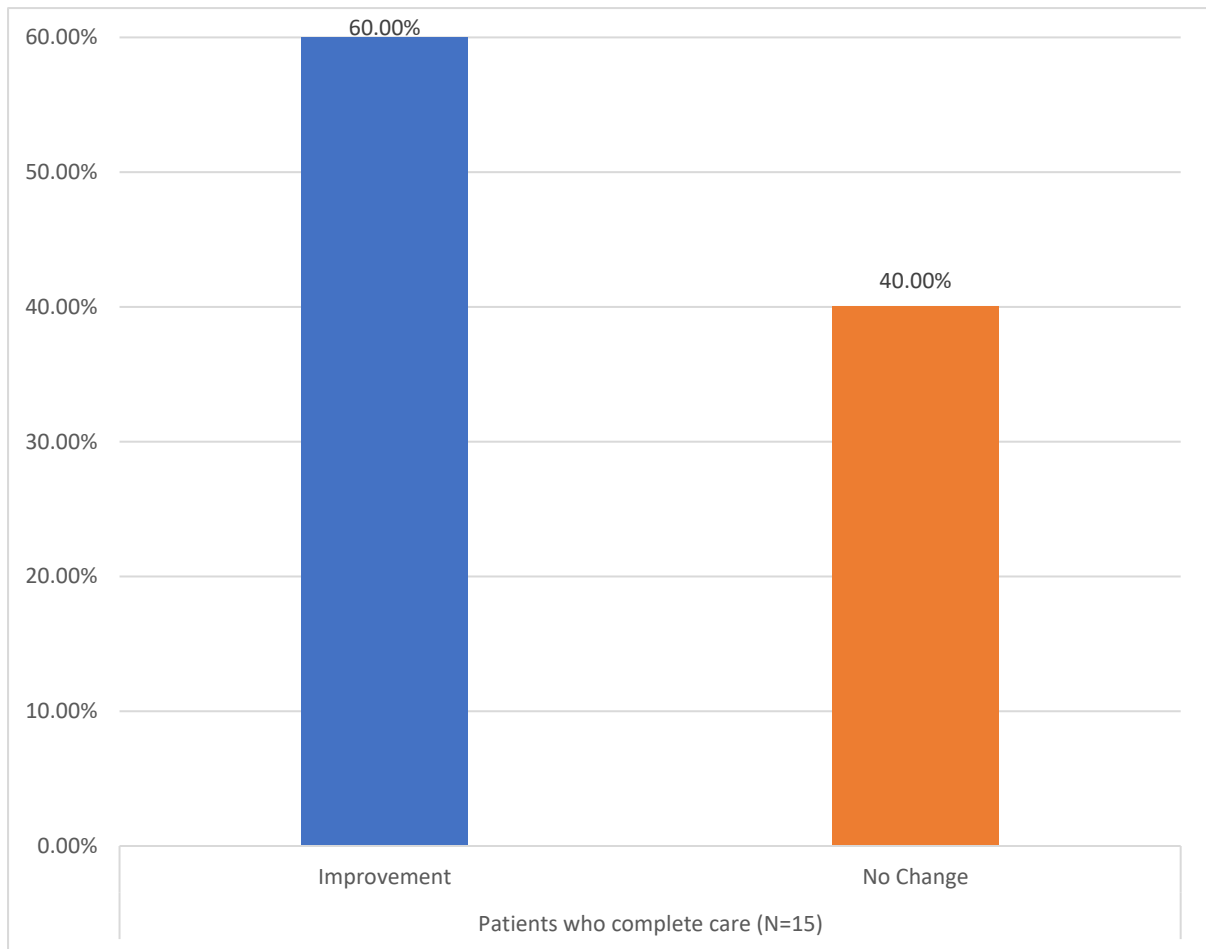
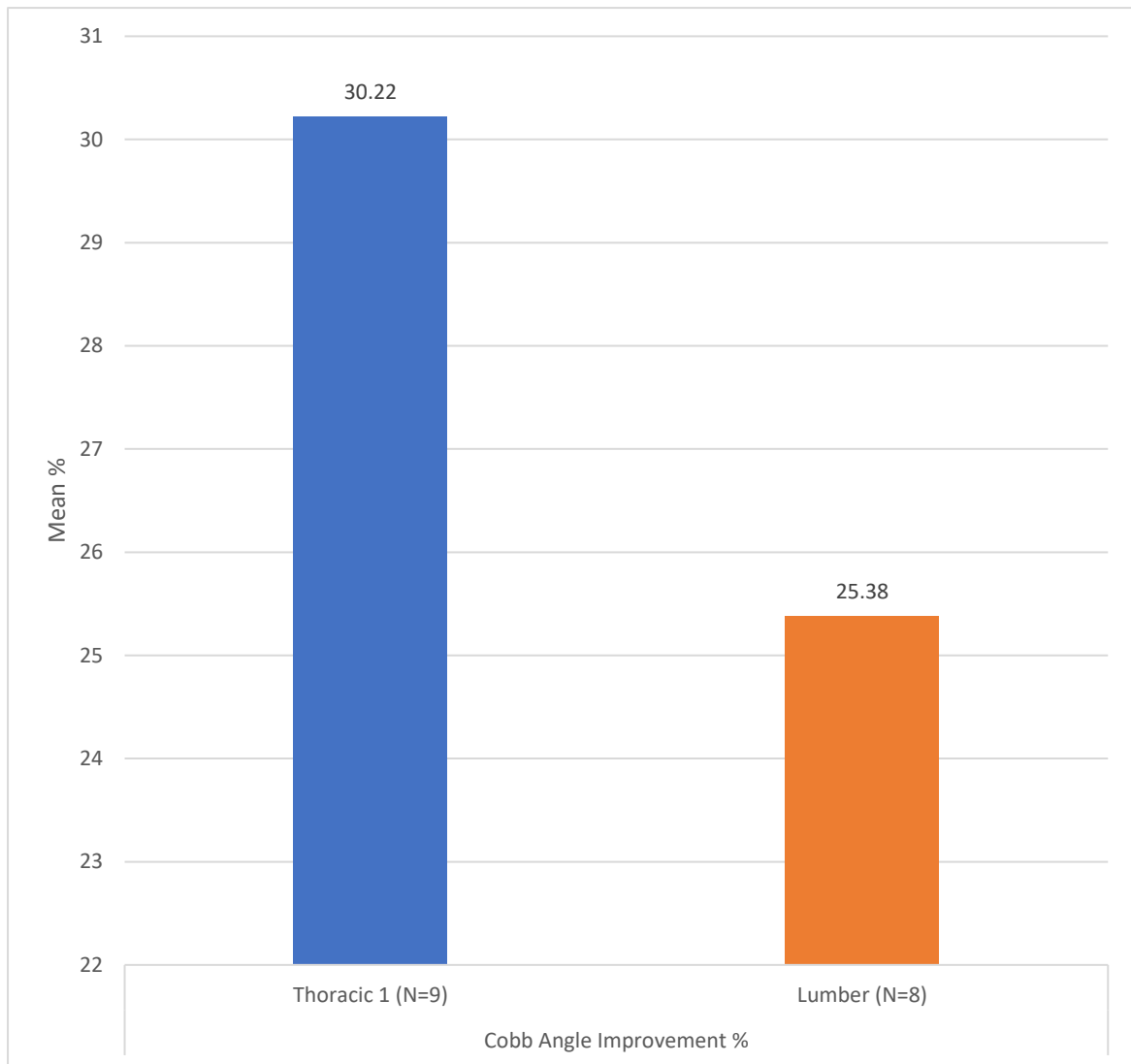


Figure 12. Percentage Improvement in Cobb Angle by Curve Type (%) - Age < 18 (Child)



Longitudinal Changes in Thoracic Cobb Angle and Linear Mixed Model Analysis in Patients Aged <18 Years

The longitudinal analysis of thoracic Cobb angle in patients aged <18 years demonstrated significant changes across treatment time points. A substantial and statistically significant reduction was observed from baseline ($27.36 \pm 12.71^\circ$) to in-brace X-ray ($9.57 \pm 8.22^\circ$; $p < 0.001$), indicating strong immediate correction with bracing. However, a significant increase in Cobb angle was noted between in-brace and 1-year follow-up ($9.00 \pm 8.96^\circ$ vs. $21.29 \pm 14.24^\circ$, $p = 0.017$), suggesting partial loss of initial correction. Between 1-year and 2-year follow-up, a modest, non-significant improvement was observed ($25.17 \pm 10.63^\circ$ vs. $22.50 \pm 12.74^\circ$, $p = 0.242$). Linear mixed model analysis further supported these findings, showing that the brace X-ray time point was associated with a significant reduction in Cobb angle compared to baseline (estimate: -20.08 , 95% CI -26.84 to -13.32 , $p < 0.001$), while the differences at 1-year ($p = 0.174$) and 2-year ($p = 0.253$) were not statistically significant. Overall, these findings suggest that in pediatric patients, bracing provides strong immediate correction of thoracic curves, but some degree of regression occurs over time, with no statistically significant long-term differences observed beyond the initial correction phase. (Figure 13)

Table 6. Longitudinal Changes in Thoracic Cobb Angle and Linear Mixed Model Analysis in Patients Aged <18 Years

	N	Mean \pm SD	Mean \pm SD	P value ^t
Thoracic 1	14	Start	Brace X-ray	<0.001*
		27.3571 ± 12.70740	9.5714 ± 8.22486	
	7	Brace X-ray	1 Year	0.017*
		9.0000 ± 8.96289	21.2857 ± 14.24446	
	6	1 Year	2 Year	0.242
		25.1667 ± 10.62858	22.5000 ± 12.73970	

^tPaired Sample t test
* $p < 0.05$, Significant

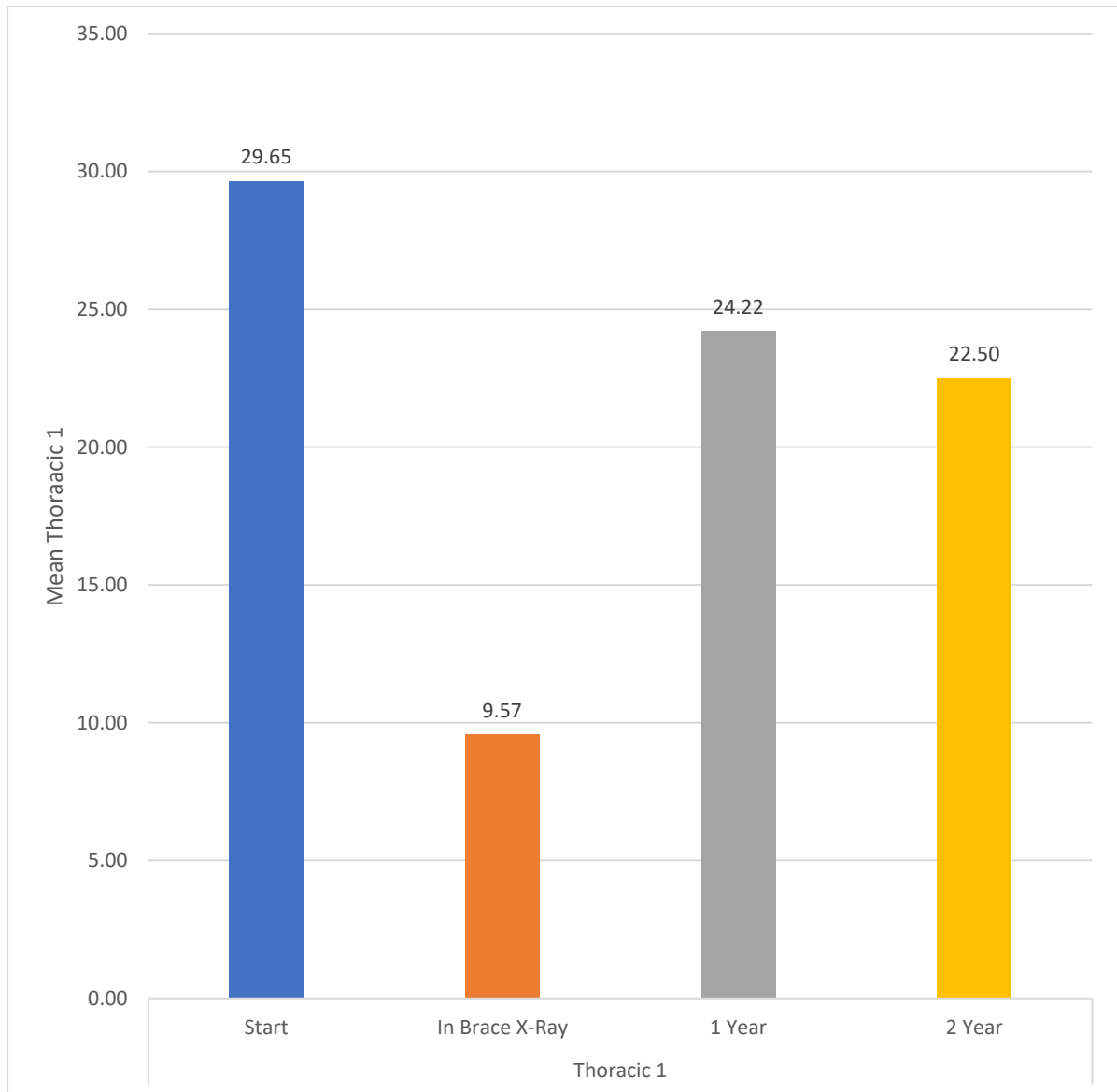
Estimates of Fixed Effects							
Parameter	Std. Error	df	t	Estimate	95% Confidence Interval		P value
					Lower Bound	Upper Bound	
Intercept	2.538711	42.000	11.680	29.651163	24.527836	34.774489	<0.001*
Time Point	Start	Ref	Ref	Ref	Ref	Ref	Ref
	Brace X-ray	3.358136	45.663	-5.979	-	-	<0.001*
	1 Year	3.922158	41.600	-1.384	-5.428941	-	0.174
	2 Year	5.787491	7.615	-1.236	-7.151163	-	0.253

Age Group = Age < 18 Years (Child)

a. Dependent Variable: Thoracic 1.

b. This parameter is set to zero because it is redundant.

Figure 13. Mean Thoracic Cobb Angle Changes Across Treatment Time Points (Cobb Angle in Degrees) - Age < 18 (Child)



Longitudinal Changes in Lumbar Cobb Angle and Linear Mixed Model Analysis in Patients Aged <18 Years

The longitudinal evaluation of lumbar Cobb angle in patients aged <18 years demonstrated significant changes across treatment time points. A marked and statistically significant reduction was observed from baseline ($30.15 \pm 13.22^\circ$) to in-brace X-ray ($5.92 \pm 6.41^\circ$; $p < 0.001$), indicating strong immediate correction with bracing. However, a significant increase in Cobb angle was noted between in-brace and 1-year follow-up ($6.57 \pm 8.14^\circ$ vs. $20.86 \pm 15.00^\circ$, $p = 0.007$), suggesting partial loss of the initial correction. Between 1-year and 2-year follow-up, a modest, non-significant improvement was observed ($28.40 \pm 11.15^\circ$ vs. $24.60 \pm 14.05^\circ$, $p = 0.223$). Linear mixed model analysis further supported these findings, showing that the brace X-ray time point was associated with a significant reduction in Cobb angle compared to baseline (estimate: -22.72 , 95% CI -27.89 to -17.54 , $p < 0.001$), while differences at 1-year ($p = 0.159$) and 2-year ($p = 0.607$) were not statistically significant. Overall, these findings suggest that in pediatric patients, bracing provides substantial immediate correction in lumbar curves; however, some regression occurs over time, with no statistically significant long-term differences observed beyond the initial correction phase. (Figure 14)

Table 7. Longitudinal Changes in Lumbar Cobb Angle and Linear Mixed Model Analysis in Patients Aged <18 Years

	N	Mean \pm SD	Mean \pm SD	P value ^t
Lumber	13	Start	Brace X-ray	<0.001*
		30.1538 \pm 13.22149	5.9231 \pm 6.40913	
	7	Brace X-ray	1 Year	0.007*
		6.5714 \pm 8.14160	20.8571 \pm 15.00476	
	5	1 Year	2 Year	0.223
		28.4000 \pm 11.14899	24.6000 \pm 14.04635	

^tPaired Sample t test
* $p < 0.05$, Significant

Estimates of Fixed Effects

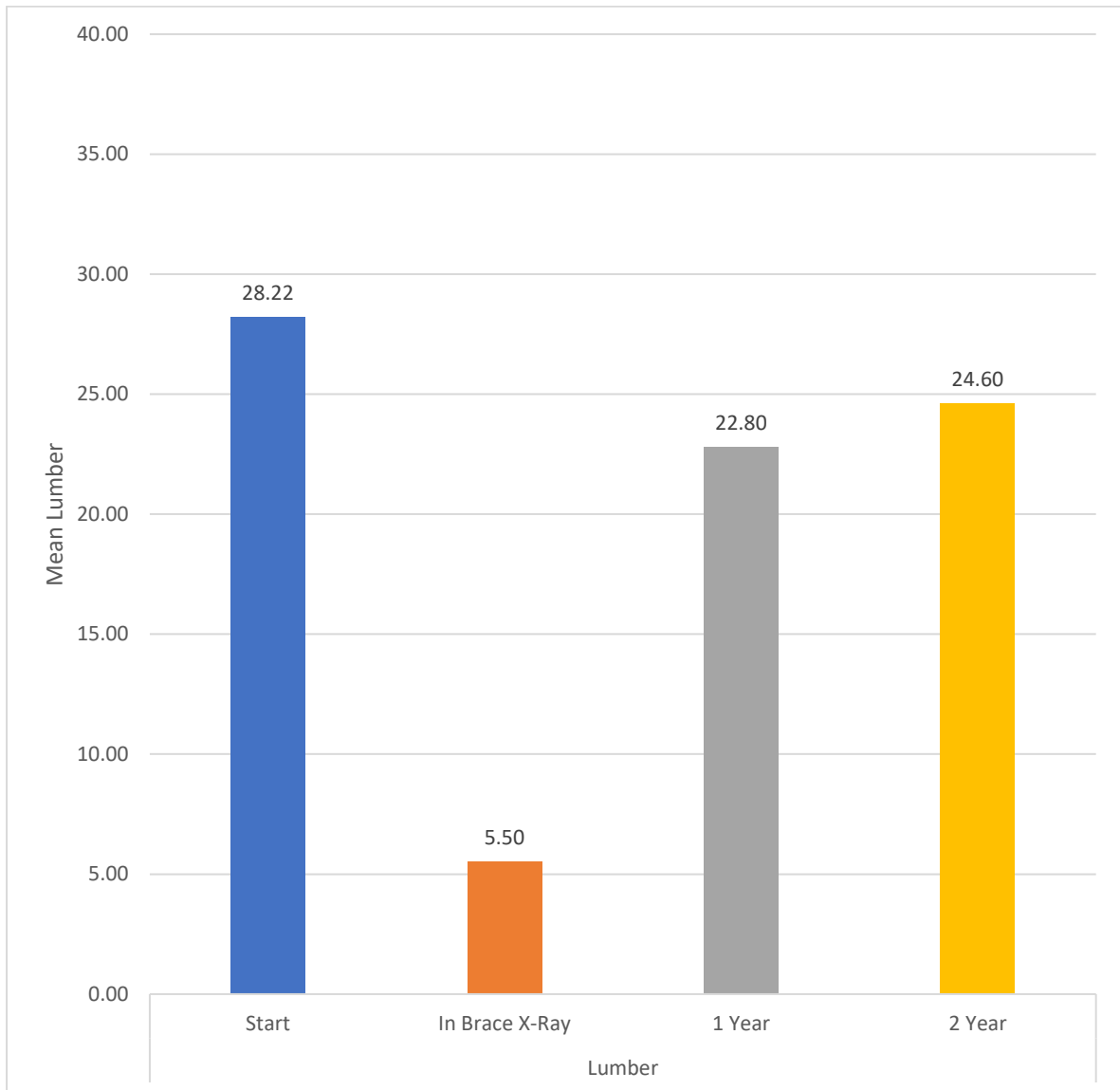
Parameter	Std. Error	df	t	Estimate	95% Confidence Interval		P value
					Lower Bound	Upper Bound	
Intercept	1.920779	36.000	14.690	28.216216	24.320696	32.111737	<0.001*
Time							
Point							
	Start	Ref	Ref	Ref	Ref	Ref	Ref
	Brace X-ray	2.564518	42.431	-8.858	-	-	<0.001*
	1 Year	3.727103	24.701	-1.453	-5.416216	27.890068	0.159
	2 Year	6.568820	4.778	-.551	-3.616216	17.542364	0.607
					13.097050	20.740290	

Age Group = Age < 18 Years (Child)

a. Dependent Variable: Lumber.

b. This parameter is set to zero because it is redundant.

Figure 14. Mean Lumbar Cobb Angle Changes Across Treatment Time Points (Cobb Angle in Degrees) - Age < 18 (Child)



Sub Group Analysis Age ≥18 Years (N=70)

Baseline Characteristics, Treatment Outcomes, and Cobb Angle Changes in Patients Aged ≥18 Years

A total of 70 adult patients (≥18 years) were included, with a mean age of 43.83 ± 20.33 years (**Figure 15**). The majority were female (78.6%) (**Figure 16**), and 71.4% were compliant with treatment. At baseline, mean Cobb angles were $31.35 \pm 14.83^\circ$ for thoracic 1, $32.11 \pm 16.07^\circ$ for thoracic 2, and $30.67 \pm 14.99^\circ$ for lumbar curves, indicating moderate curve severity. In-brace X-ray measurements demonstrated notable immediate correction, with mean Cobb angles reduced to $15.50 \pm 16.51^\circ$ for thoracic 1 and $12.50 \pm 15.73^\circ$ for lumbar curves. At 1-year follow-up, mean Cobb angles were $26.16 \pm 11.92^\circ$ (thoracic 1), $26.33 \pm 12.80^\circ$ (thoracic 2), and $21.84 \pm 9.86^\circ$ (lumbar), with limited 2-year follow-up data showing further variability. The mean reduction in Cobb angle was $-4.97 \pm 5.00^\circ$ for thoracic 1, $-6.00 \pm 6.48^\circ$ for thoracic 2, and $-3.62 \pm 5.76^\circ$ for lumbar curves. Most patients (94.3%) were treated using a combination of brace and table therapy. Among patients who completed care (N=33), 63.6% showed improvement, while 36.4% had no change (**Figure 18**). Additionally, 29.0% of patients discontinued care and 23.2% were still undergoing treatment (**Figure 17**). The percentage improvement in Cobb angle averaged 30.74% for thoracic 1, 44.00% for thoracic 2, and 26.07% for lumbar curves (**Figure 19**). Overall, these findings suggest that the treatment approach provides meaningful correction in adult patients, with substantial immediate in-brace effects and moderate sustained improvements, and that treatment effectiveness appears comparable to that observed in younger patients despite age differences.

Table 8. Baseline Characteristics, Treatment Outcomes, and Cobb Angle Changes in Patients Aged ≥18 Years

		Mean ± SD	Median (IQR)	N	%
Age Years		43.83 ± 20.33	37.50 (25.00-63.00)		
Gender	Female			55	78.6%
	Male			15	21.4%
Care Compliant	No			20	28.6%
	Yes			50	71.4%
Start Cobb	Thoracic 1 (N=66)	31.35 ± 14.83	29.00 (21.00-40.00)		
	Thoracic 2 (N=9)	32.11 ± 16.07	33.00 (17.00-45.00)		
	Lumber (N=61)	30.67 ± 14.99	28.00 (20.00-38.00)		
In Brace X-Ray	Thoracic 1 (N=22)	15.50 ± 16.51	14.50 (6.00-18.00)		
	Thoracic 2 (N=1)	27.00 ± .	27.00 (27.00-27.00)		
	Lumber (N=20)	12.50 ± 15.73	8.00 (0.00-17.00)		
1 Yr. Cobb	Thoracic 1 (N=31)	26.16 ± 11.92	28.00 (15.00-32.00)		
	Thoracic 2 (N=6)	26.33 ± 12.80	29.00 (14.00-35.00)		
	Lumber (N=25)	21.84 ± 9.86	22.00 (16.00-28.00)		

2 Yr. Cobb	Thoracic 1 (N=4)	25.50 ± 6.14	25.50 (21.50-29.50)
	Thoracic 2 (N=1)	33.00 ± .	33.00 (33.00-33.00)
	Lumber (N=3)	14.67 ± 8.62	13.00 (7.00-24.00)
Cobb Angle Change	Thoracic 1 (N=31)	-4.97 ± 5.00	-4.00 (-8.00-0.00)
	Thoracic 2 (N=6)	-6.00 ± 6.48	-5.50 (-8.00-0.00)
	Lumber (N=26)	-3.62 ± 5.76	-2.50 (-7.00-0.00)
Brace/Table	Both		66 94.3%
	Brace		2 2.9%
	Table		2 2.9%
Results	Currently in care		16 23.2%
	Based on Patients who complete care (N=33)	Improvement	21 63.6%
		No Change	12 36.4%
	Stopped care		20 29.0%
Cobb Angle Improvement %	Thoracic 1 (N=19)	30.74 ± 12.85	28.00 (21.00-35.00)
	Thoracic 2 (N=3)	44.00 ± 18.68	47.00 (24.00-61.00)
	Lumber (N=14)	26.07 ± 17.05	23.00 (13.00-32.00)

Figure 15. Distribution of Patient Age in Years (Age in Years) - Age ≥ 18 (Adult)

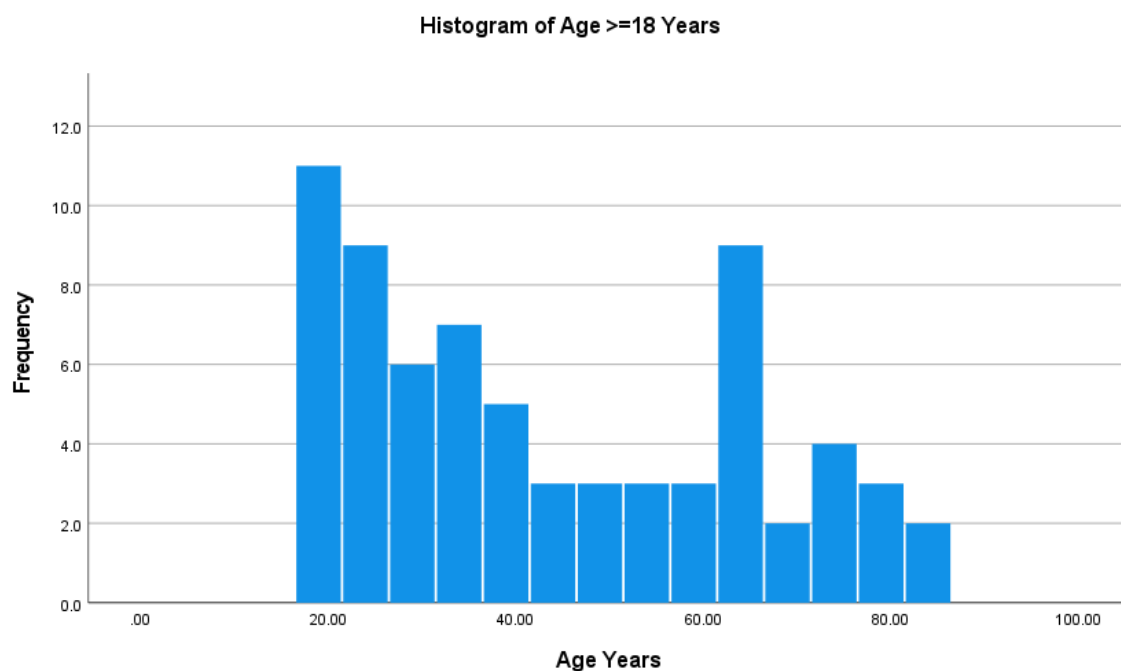


Figure 16. Gender Distribution of Study Participants (% , N) - Age \geq 18 (Adult)

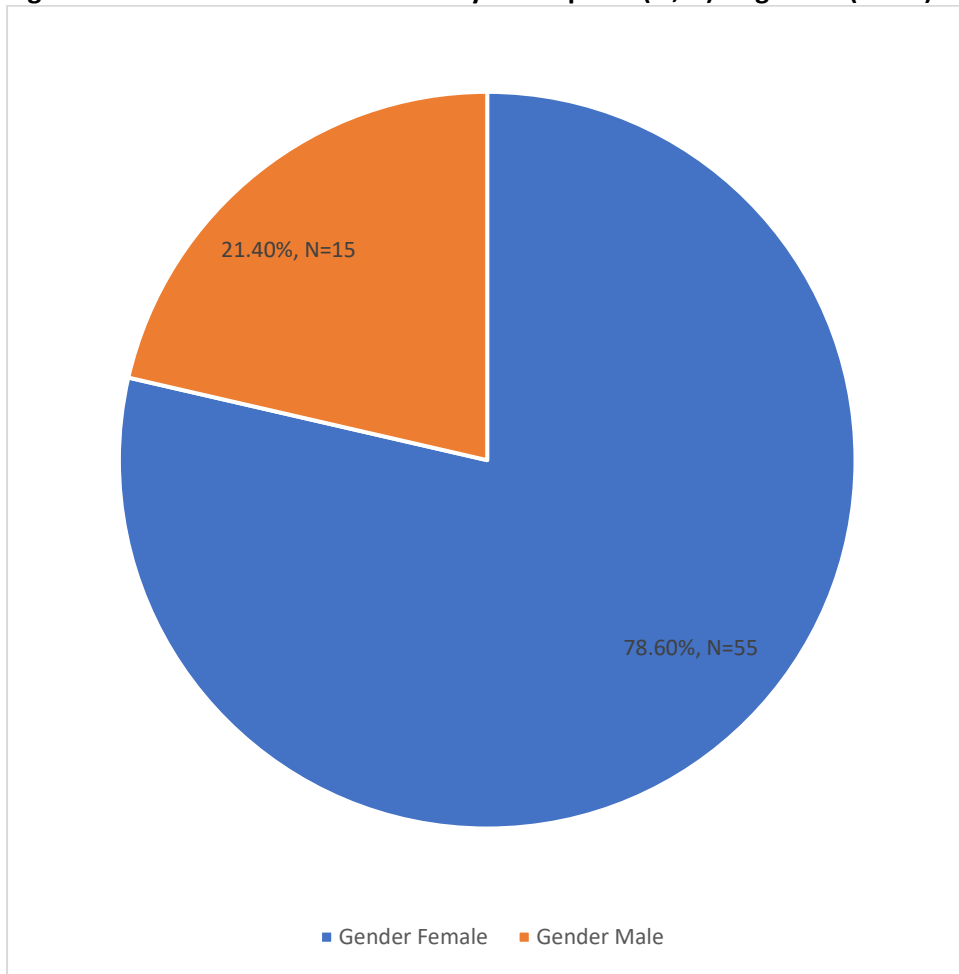


Figure 17. Patient Outcomes Following Scoliosis Treatment (%) - Age ≥ 18 (Adult)

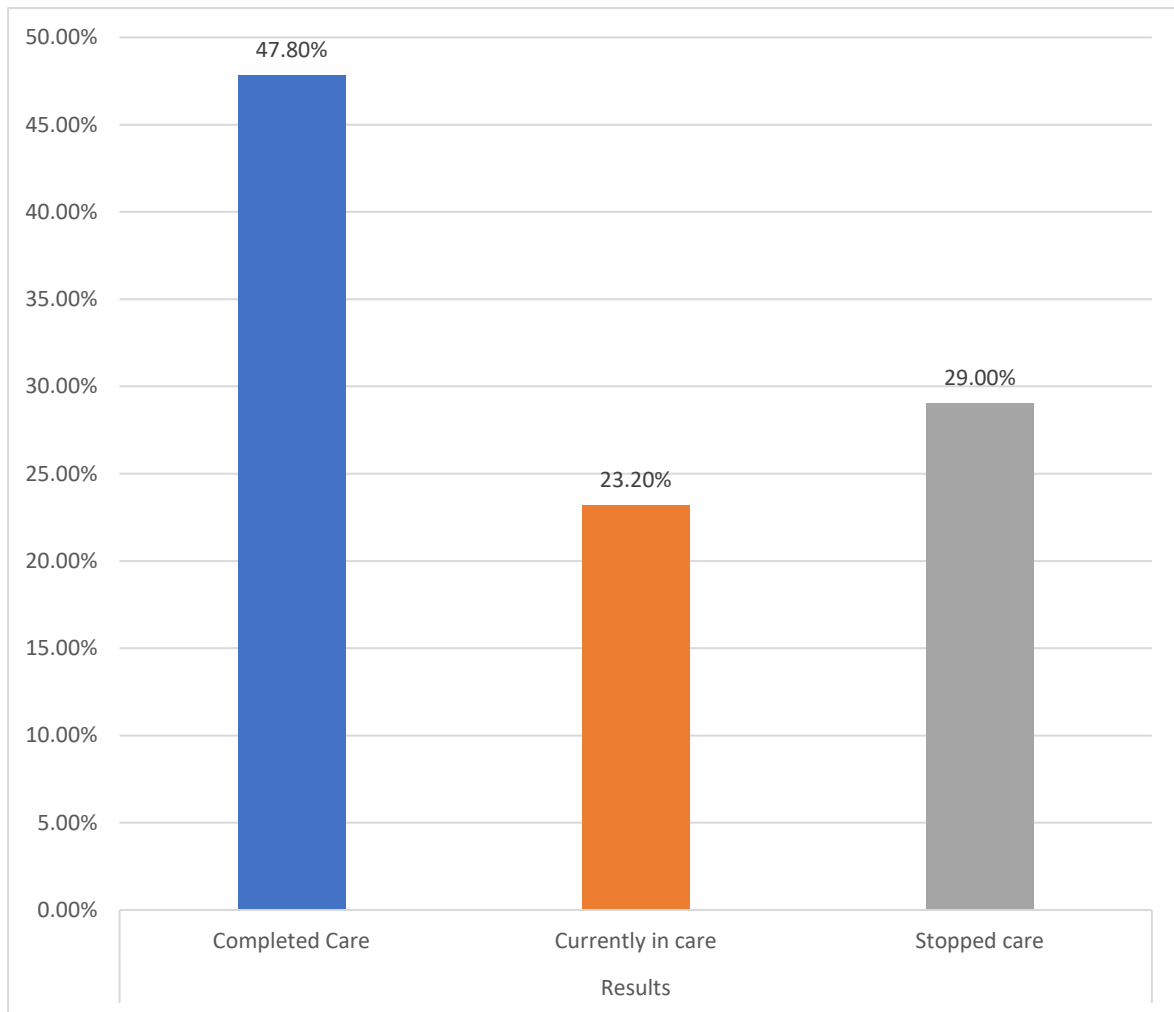


Figure 18. Treatment Outcomes Among Patients Who Completed Care (%) - Age \geq 18 (Adult)

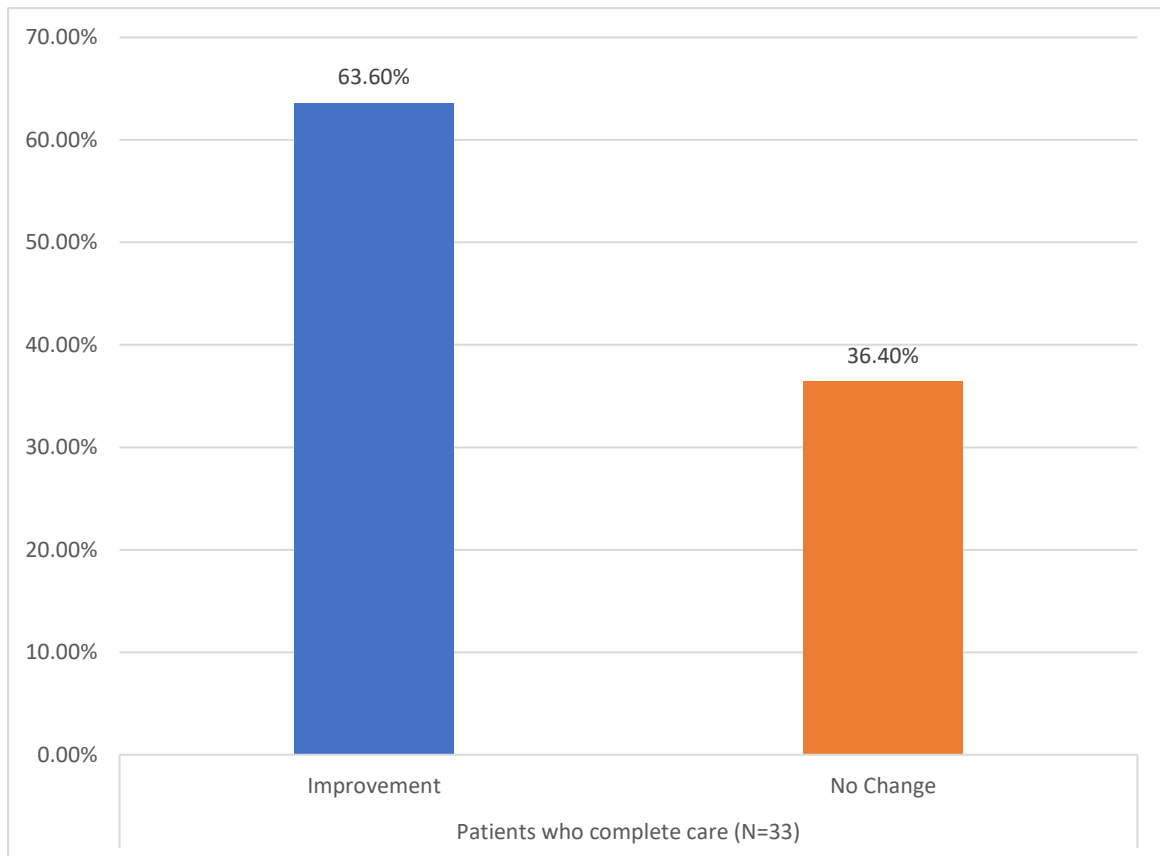
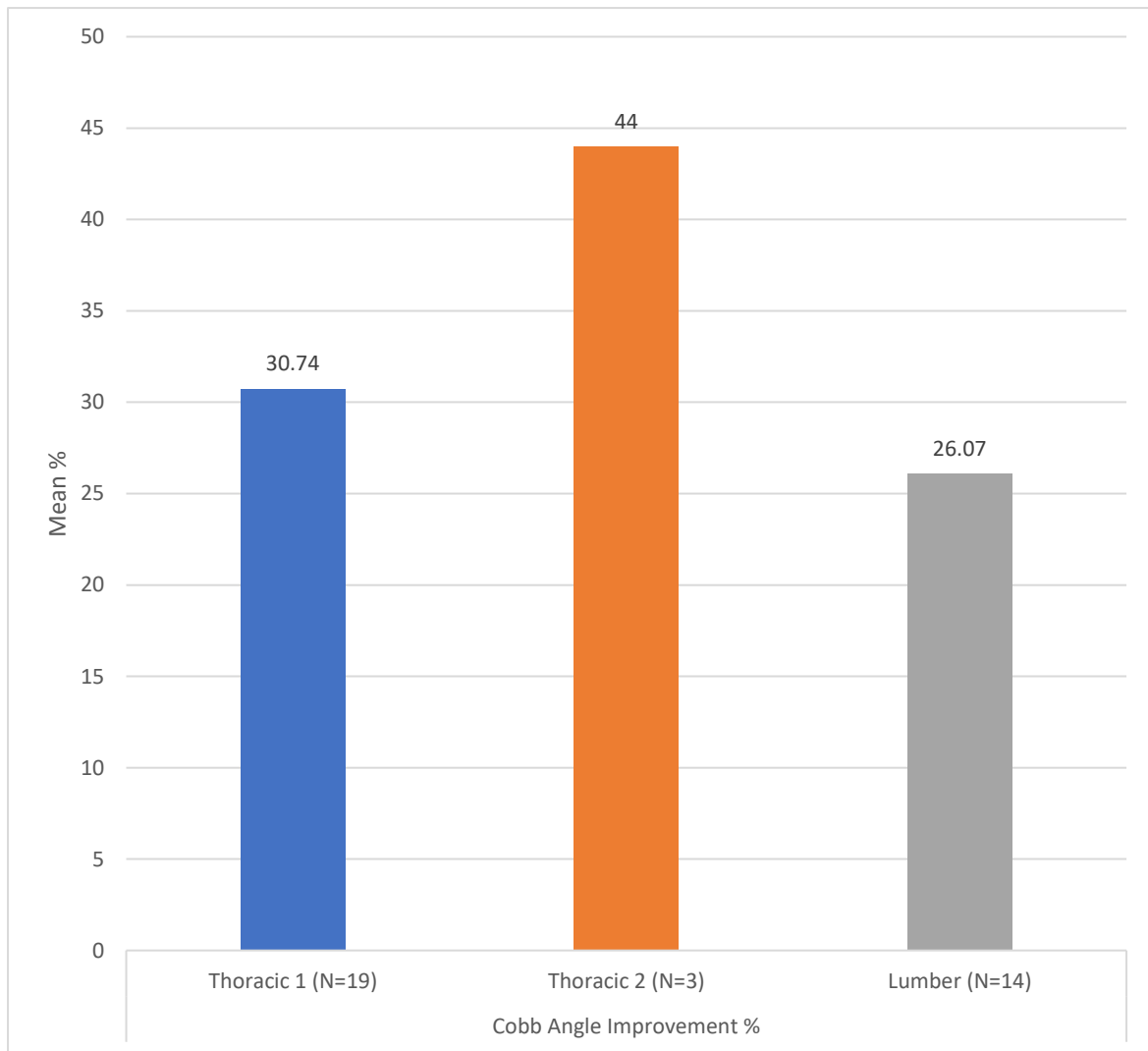


Figure 19. Percentage Improvement in Cobb Angle by Curve Type (%) - Age \geq 18 (Adult)



Longitudinal Changes in Thoracic Cobb Angle and Linear Mixed Model Analysis in Patients Aged ≥ 18 Years

The longitudinal analysis of thoracic Cobb angle in adult patients (≥ 18 years) demonstrated significant changes across treatment time points. A substantial and statistically significant reduction was observed from baseline ($33.45 \pm 16.06^\circ$) to in-brace X-ray ($15.50 \pm 16.51^\circ$; $p < 0.001$), indicating strong immediate correction with bracing. However, a significant increase in Cobb angle was noted between in-brace and 1-year follow-up ($10.30 \pm 9.17^\circ$ vs. $24.30 \pm 11.66^\circ$, $p = 0.001$), suggesting partial loss of the initial correction. Between 1-year and 2-year follow-up, a modest, non-significant improvement was observed ($31.00 \pm 2.65^\circ$ vs. $28.00 \pm 4.36^\circ$, $p = 0.225$). Linear mixed model analysis further supported these findings, showing that the brace X-ray time point was associated with a significant reduction in Cobb angle compared to baseline (estimate: -15.85 , 95% CI -23.91 to -7.78 , $p < 0.001$), while differences at 1-year ($p = 0.069$) and 2-year ($p = 0.157$) were not statistically significant. Overall, these findings suggest that in adult patients, bracing provides strong immediate correction of thoracic curves, but some regression occurs over time, with no statistically significant long-term differences observed beyond the initial correction phase. (Figure 20)

Table 9. Longitudinal Changes in Thoracic Cobb Angle and Linear Mixed Model Analysis in Patients Aged ≥ 18 Years

	N	Mean \pm SD	Mean \pm SD	P value ^t
Thoracic 1	22	Start 33.4545 \pm 16.06157	Brace X-ray 15.5000 \pm 16.50613	<0.001*
	10	Brace X-ray 10.3000 \pm 9.16576	1 Year 24.3000 \pm 11.66238	0.001*
	3	1 Year 31.0000 \pm 2.64575	2 Year 28.0000 \pm 4.35890	0.225

^tPaired Sample t test
* $p < 0.05$, Significant

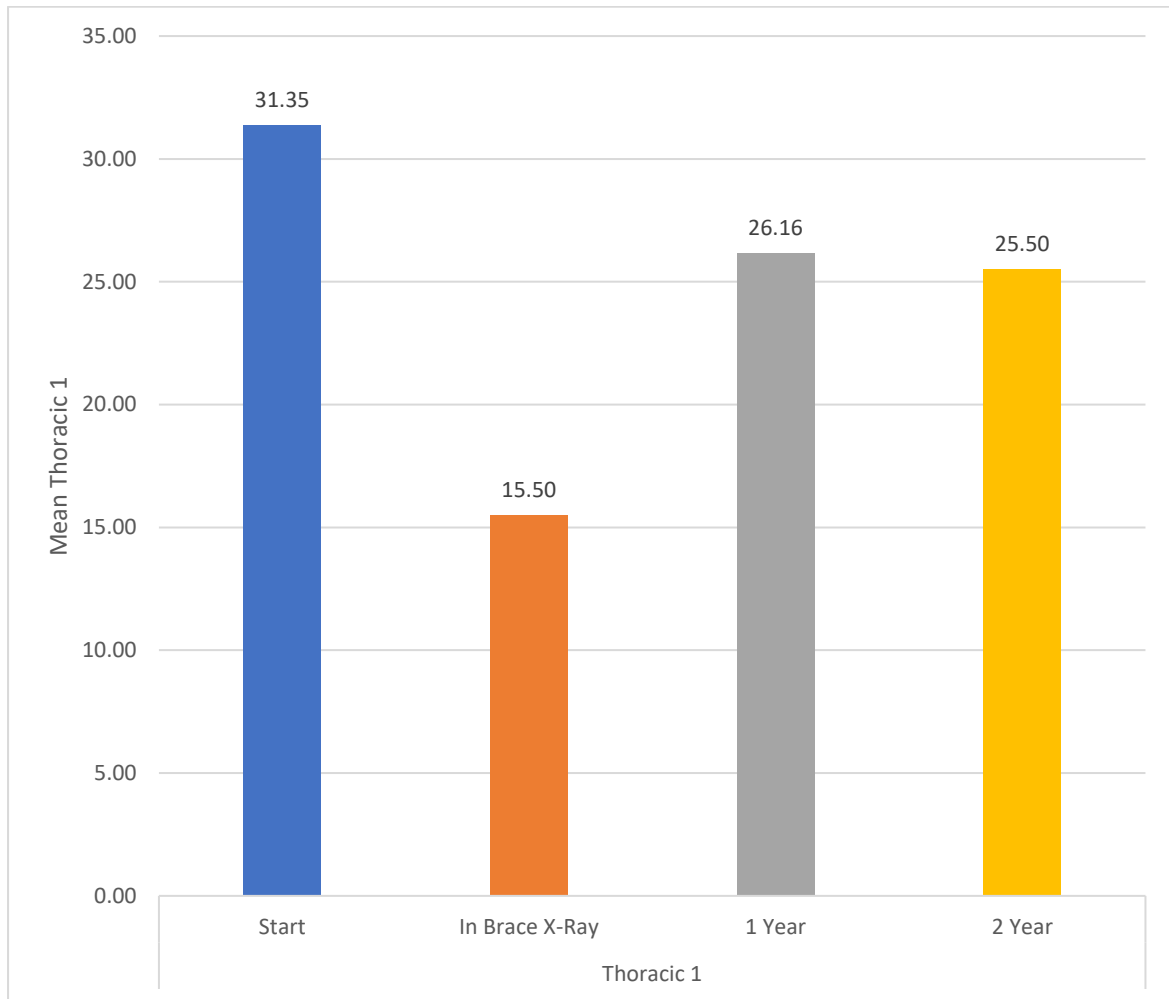
Estimates of Fixed Effects								
Parameter		Std. Error	df	t	Estimate	95% Confidence Interval		P value
						Lower Bound	Upper Bound	
Intercept		1.825422	65.000	17.173	31.348485	27.702866	34.994104	<0.001*
Time Point	Start	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Brace X-ray	3.964387	33.048	-3.998	-	-	-7.783325	<0.001*
	1 Year	2.813773	71.918	-1.844	-5.187195	-	.422069	0.069
	2 Year	3.570551	5.467	-1.638	-5.848485	-	3.098939	0.157

Age Group = Age ≥ 18 Years (Adult)

a. Dependent Variable: Thoracic 1.

b. This parameter is set to zero because it is redundant.

Figure 20. Mean Thoracic Cobb Angle Changes Across Treatment Time Points (Cobb Angle in Degrees) - Age ≥ 18 (Adult)



Longitudinal Changes in Lumbar Cobb Angle and Linear Mixed Model Analysis in Patients Aged ≥18 Years

The longitudinal evaluation of lumbar Cobb angle in adult patients (≥18 years) revealed significant changes over the course of treatment. A statistically significant reduction was observed from baseline ($30.89 \pm 15.23^\circ$) to in-brace X-ray ($13.89 \pm 16.00^\circ$; $p < 0.001$), indicating strong immediate correction with bracing. However, a significant increase in Cobb angle between in-brace and 1-year follow-up ($8.43 \pm 6.83^\circ$ vs. $21.57 \pm 9.95^\circ$, $p < 0.001$) suggests a partial loss of the initial correction. Between 1-year and 2-year follow-up, a slight, non-significant change was noted ($17.50 \pm 6.36^\circ$ vs. $18.50 \pm 7.78^\circ$, $p = 0.277$). The linear mixed model analysis demonstrated that both the brace X-ray (estimate: -18.17 , 95% CI -26.34 to -10.00 , $p < 0.001$) and 1-year time points (estimate: -8.83 , 95% CI -14.32 to -3.34 , $p = 0.002$) were associated with significantly lower Cobb angles compared to baseline, while the 2-year time point did not reach statistical significance ($p = 0.068$). Overall, these findings suggest that in adult patients, bracing provides substantial short-term correction of lumbar curves, with some regression occurring over time; however, a portion of the correction remains significant at 1 year, indicating partial maintenance of treatment effect despite longer-term variability. (Figure 21)

Table 10. Longitudinal Changes in Lumbar Cobb Angle and Linear Mixed Model Analysis in Patients Aged ≥18 Years

	N	Mean ± SD	Mean ± SD	P value [†]
Lumber	18	Start	Brace X-ray	<0.001*
		30.8889 ± 15.23498	13.8889 ± 16.00327	
	7	Brace X-ray	1 Year	<0.001*
		8.4286 ± 6.82781	21.5714 ± 9.94748	
	2	1 Year	2 Year	0.277
		17.5000 ± 6.36396	18.5000 ± 7.77817	

[†]Paired Sample t test

* $p < 0.05$, Significant

Estimates of Fixed Effects

Parameter	Std. Error	df	t	Estimate	95% Confidence Interval		P value
					Lower Bound	Upper Bound	
Intercept	1.918806	60	15.985	30.672131	26.833948	34.510314	<0.001*
Time							
Point	Start	Ref	Ref	Ref	Ref	Ref	Ref
	Brace X-ray	4.006603	31.119	-4.536	-	-	<0.001*
	1 Year	2.751499	66.951	-3.210	-8.832131	-3.340042	0.002*
	2 Year	5.334753	2.637	-3.000	-	2.375847	0.068
				16.005464	34.386776		

Age Group = Age ≥ 18 Years (Adult)

a. Dependent Variable: Lumber.

b. This parameter is set to zero because it is redundant.

Figure 21. Mean Lumbar Cobb Angle Changes Across Treatment Time Points (Cobb Angle in Degrees) - Age ≥ 18 (Adult)

