

# HALO TRACTION EFFECTIVENESS IN THE MANAGEMENT OF CHILDREN WITH SEVERE RIGID SCOLIOSIS

*Original Research*

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## ABSTRACT

**Objective:** To evaluate efficacy of halo-gravity traction in pediatric patients with severe rigid scoliosis.

**Methodology:** We enrolled twenty five pediatric patients with severe rigid scoliosis were. All patients underwent halo device application under general anesthesia using six-pin fixation in standard cranial safe zones. Traction was initiated at 2-3 kg and progressively increased to a maximum of 50% body weight with adjustments based on individual tolerance and radiographic response. Radiographic evaluations were documented for spinal alignment changes with particular focus on coronal Cobb angle and kyphosis measurements. All surgical procedures were performed by experienced spinal surgeons.

**Results:** Mean age was  $12.80 \pm 2.81$  years. Significant radiographic improvements were observed with mean coronal Cobb angles reducing from  $102.44 \pm 14.78$  degrees to  $42.88 \pm 3.53$  degrees post-surgery ( $p < 0.0001$ ). Kyphosis improved from  $64.72 \pm 17.96$  degrees to  $31.12 \pm 7.81$  degrees post-surgery ( $p < 0.0001$ ). One patient had pin tract infection and one patient had CSF leak.

**Conclusion:** Preoperative halo-gravity traction exhibited an effective and safe approach for managing severe rigid scoliosis in pediatric patients.

**Keywords:** severe scoliosis, halo-gravity traction, spinal deformity, pediatric orthopedics, preoperative management, spinal correction

## INTRODUCTION

Scoliosis surgery is mainly focused on attaining a balanced spine for aesthetic reasons in most cases. Severe as well as rigid scoliotic curves, in addition to aesthetic problems are linked to cardiopulmonary compromise as well as may result in considerable morbidity and mortality if not addressed. The curves demonstrate a pronounced tendency to maintain progression throughout adulthood, consequently exacerbating issue <sup>[1-3]</sup>. In serious cases, they may result within late-onset neurological disorders. Consequently, conventional therapy is ineffective in management of serious rigid scoliosis. The management of cases requiring surgery offers significant challenges as well as inherent risks making the establishment of a consensus upon standard treatment difficult. Managing severe rigid scoliosis offers significant challenges due to typically stiff nature of spinal deformity, with correction usually requiring radical release as well as osteotomy of spine. Prolongs surgery duration which results in considerable blood loss along with a higher likelihood of neurologic deficits as well as complications related to wounds and chest among other issues. The advantages of procedure extend significantly across cosmetic, pulmonary as well as overall health domains. Additionally, avoiding further neurological impairment and progression of deformities may contribute to a prolonged lifespan and enhanced quality of life for numerous patients <sup>[4-7]</sup>.

Traction techniques including halo tibial as well as halo-femoral offer significant corrections; yet they necessitate extended periods of bed rest. Halo gravity traction promotes mobilization and improves patient compliance <sup>[8, 9]</sup>. Halo traction is originally designed for cervical spine injuries which has been repurposed for management of scoliosis, particularly in instances of severe as well as rigid deformities <sup>[10]</sup>. Halo traction relies on controlled, continuous longitudinal force on spine, enabling gradual correction over time. This technique enhances curve flexibility, minimizes rib prominence along with improves overall spinal balance. This pre-operative treatment approach can improve the security and effectiveness of following surgical procedures, often leading to better outcomes in patients at elevated risk for challenges <sup>[11, 12]</sup>.

Severe rigid scoliosis in children presents a significant challenge in spinal deformity correction due to reduced flexibility of curvature as well as increased risk of neurological injury during surgical intervention. Halo-gravity traction has emerged as an effective preoperative adjunctive therapy aimed at gradually improving spinal alignment and reducing the risk of intraoperative complications. Evaluating the effectiveness of halo traction in children with severe rigid scoliosis is essential to validate its role in improving surgical outcomes and enhancing overall quality of life in such vulnerable population.

## METHODOLOGY

This descriptive study was conducted over a period of 12-months from March 2024 to March 2025 after at Khyber Teaching Hospital, Peshawar. We included 25 pediatric patients, aged 8 to 15 years diagnosed with severe rigid scoliosis requiring surgical intervention. We obtained consent from the parents/guardians of the patients.

All participants underwent preoperative halo-gravity traction. The halo device was applied under general anesthesia using six fixation pins placed in standard safe zones followed by gradual traction initiation at 2-3 kg and incremental increases up to 50% of body weight based on individual tolerance.

Serial radiographic evaluations were performed weekly to monitor spinal alignment changes with particular attention to the coronal Cobb angles and kyphosis measurements. Neurological assessments were conducted twice daily to detect any traction-related complications. The pre-traction, post-traction and post-surgical radiographic parameters were compared. Effectiveness of halo traction was defined operationally as a measurable improvement in spinal curvature and/or overall patient condition following the application of halo-gravity or halo-pelvic traction in patients diagnosed with severe rigid scoliosis (Cobb angle > 70° with < 30% flexibility on bending films). Clinical outcomes along with complication rates were systematically recorded throughout the treatment period. The study maintained rigorous protocols for pin site care and infection prevention with all procedures performed by experienced spinal surgeons at a single institution.

Statistically analysis was done using SPSS 26. For numerical data we used mean and standard deviation while for categorical data like gender, we used frequency and percentages. Comparison of coronal Cobb angles and kyphosis measurements at different points was done using Friedman test, keeping P value statistically notable at < 0.05.

RESULTS

The mean age of 25 patients was 12.80±2.81 years. In our cohort 14 (56%) were male and 11 (44%) were females patients (Figure 1). Radiographic outcomes demonstrated substantial improvements in spinal alignment following halo traction and subsequent surgery. The mean kyphosis angle decreased from 64.72±17.96 degrees before traction to 41.96±11.62 degrees post-traction with further reduction to 31.12±7.81 degrees after surgery (p<0.0001). Coronal Cobb angle showed notable correction decreasing from 102.44±14.78 degrees pre-traction to 54.72±4.43 degrees post-traction and ultimately to 42.88±3.53 degrees post-surgery (p<0.0001) (Table 1). Complications related to halo traction were minimal with only one case each of pin tract infection and cerebrospinal fluid leak both occurring in 4% of patients (Table 2). Halo traction was effective in 80% patients

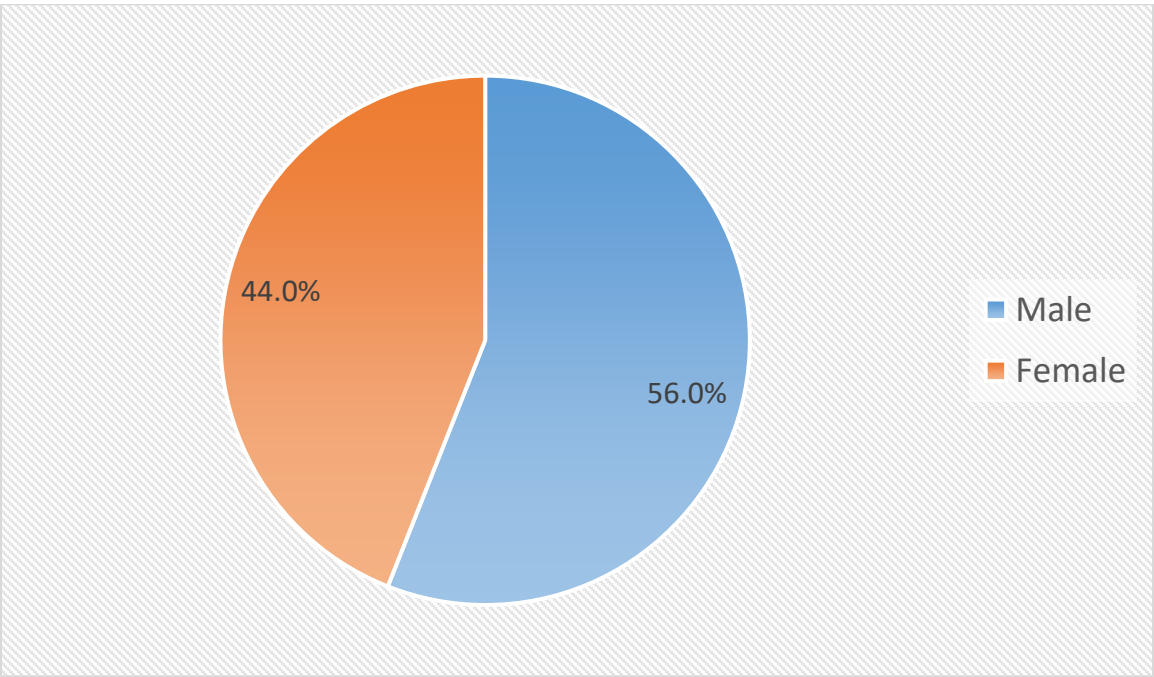


Figure 1 Gender Distribution

Table 1: Comparison of outcome variables at different time points

Variables	N	Mean	Std. Deviation	P value
Kyphosis angle pre traction	25	64.72	17.96	0.0001
Kyphosis angle post traction	25	41.96	11.62	

Kyphosis angle post-surgery	25	31.12	7.81	0.0001
Cob angle pre traction	25	102.44	14.78	
Cob angle post traction	25	54.72	4.43	
Cob angle post-surgery	25	42.88	3.53	

Table 2: Complications

Complications	Frequency	Percent
Pin tract infection	1	4.0
CSF leak	1	4.0
No complications	23	92.0
Total	25	100.0

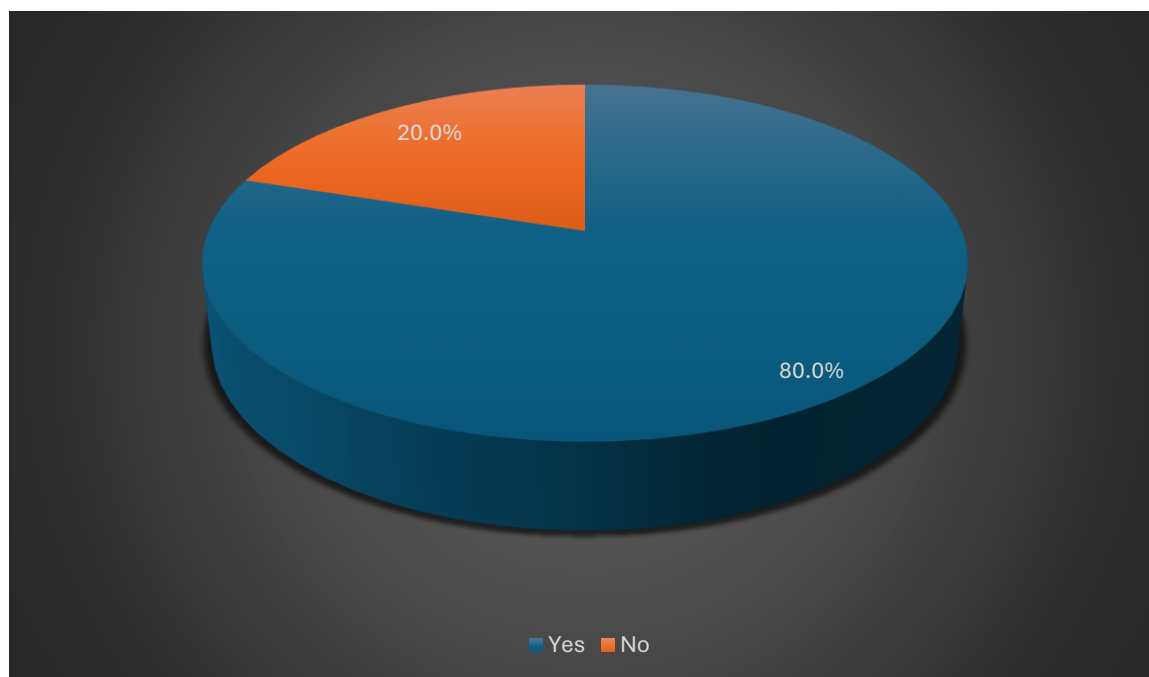


Figure 2 Effectiveness

## DISCUSSION

The findings of this study align closely with existing researches on the use of halo traction in pediatric patients with severe rigid scoliosis while also highlighting unique aspects of our cohort. The mean age of our patients was  $12.80 \pm 2.81$  years which falls within the range reported by Korkmaz et al where they reported mean age 12.8 years.<sup>13</sup> Ilyas et al and Ali et al documented a slightly higher mean age which was around 15 years. (9–27 years) confirming that halo traction is predominantly employed in adolescents with severe deformities.<sup>14,15</sup> The gender distribution in our study was 56% male and 44% female patients is almost inline with Ilyas et al where they had 52.94% male and 47.05% female patients.<sup>14</sup> Our gender distribution contrasts slightly with with Ali et al where they documented a fairly higher number of female patients.<sup>15</sup>

A key strength of our study was the lower complication rate with only 2 patients experiencing pin tract infections and cerebrospinal fluid leaks respectively. This is notably lower than the 23.3% complication rate reported by Domenech et al. where pin infections were the most frequent issue.<sup>16</sup> Our results more closely resemble those of Korkmaz et al who observed a single pin tract infection in five patients indicating that meticulous pin care and gradual traction protocols may mitigate risks.<sup>13</sup> Ali et al also documented the occurrence of CSF leak which is again inline with our findings.<sup>15</sup> The absence of neurological complications in our cohort also aligns with Korkmaz et al, in their cohort they did not experience neurological complications. However in Ali et al.'s study one patient developed paraplegia.

Radiographically our patients achieved substantial reduction in kyphosis correction during traction and post-surgery. These results parallel Korkmaz's findings where thoracic kyphosis improved from  $78.6^\circ$  to  $52.4^\circ$  after traction. Our post-surgical kyphosis angle improvement is similar to the post-surgical improvement recorded by Ilyas et al.'s modified halo-pelvic cohort.<sup>14</sup> Ali et al also reported notable improvement in post-surgical kyphosis angle.<sup>15</sup>

The coronal Cobb angle correction in our study also showed notable improvement from the baseline to post traction and then post-surgery, which mirrors the significant reduction reported by Korkmaz within three weeks' time frame.<sup>13</sup> Ilyas et al, like our study also documented improvement in Cobb angle over three different time points, which were pre-distraction, post distraction and post-surgery in their modified halo-pelvic patients.<sup>14</sup> Similarly Ali et al documented notable improvement in pre-surgery Cobb angle and post-surgery Cobb angle scores.<sup>15</sup> A review analysis conducted by Domenech et al showed that across thirteen studies, the correction in curve values was substantially relevant clinically, further affirming our findings.<sup>16</sup>

Ma et al presented a case report of fourteen year old patient who was presented with severe congenital scoliosis, demonstrated that halo traction notably improved the coronal and sagittal Cobb's angles from 100 degrees to 45 degrees and 40 degrees.<sup>17</sup>

## CONCLUSION

In conclusion, our study demonstrated that preoperative halo-gravity traction effectively and efficiently reduced severe rigid scoliosis in children achieving substantial radiographic correction with minimal complications. The results support its use as a safe bridging therapy before definitive surgery particularly for severe deformities requiring gradual correction.

### Author Contributions

Author	Contribution
Haider Ali*	Data Collection, Data Analysis, Manuscript Writing, and Manuscript Revision, Final Approval of Draft
Muhammad Asad	Critical Input, Data Entry, Final Approval of Draft
Sikandar Amjad	Literature Search, Study Methodology, Final Approval of Draft
Shahrukh Khan	Conception of Study Design, Literature Search. Final Approval of Draft

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