

Research Article

The Use of Halo-Gravity Traction and Vertebral Column Resection to Treat Children with Severe Kyphosis. Results and Complications

Oheneba Boachie-Adjei* and Kwadwo Yankey

Foundation of Orthopedics and Complex Spine (FOCOS) Orthopedic Hospital, No 8 Teshiestreet, Pantang Accra, Ghana

***Corresponding author**

Oheneba Boachie-Adjei, Foundation of Orthopedics and Complex Spine (FOCOS) Orthopedic Hospital, No 8 Teshie street, Pantang Accra, Ghana, Tel: 233 243 383051; E-mail: boachiecalendar@gmail.com

Submitted: 10 February 2017

Accepted: 12 May 2017

Published: 16 May 2017

ISSN: 2373-9312

Copyright

© 2017 Boachie-Adjei et al.

OPEN ACCESS**Keywords**

- Severe kyphosis
- Congenital kyphosis
- Neurofibromatosis kyphosis
- Complex vertebral transposition
- Vertebral column resection
- Gamma deformity

Abstract

Introduction: Children with severe kyphosis are prone to developing neurologic compromise, poor respiratory function and possible early death. Early identification and surgical intervention has proven to be effective. However they carry the highest surgical risk of all the spine deformities.

Objectives: To present the surgical results and complications of patients with severe kyphosis treated at the Foundation of Orthopedic and complex Spine (FOCOS) orthopedic hospital in Ghana with a combination of prolonged Halo gravity traction, Vertebral Column resection (VCR) and spinal stabilization.

Methods: A consecutive series of 20 consecutive pediatric patients with severe kyphotic deformities were treated with Halo gravity traction and Vertebral column resection at a single center. We gathered the following demographic and clinical data: age, gender, BMI, diagnosis, procedure, Intraoperative monitoring (IOM) events, post operative complications.

Results: 2 groups of 20 patients, 7 Early onset patients under 10 years with congenital kyphosis < 180 degrees (Group 1 N=7) and 13 adolescents patients with Kyphosis exceeding 180 degrees (Group 2 N=13). All the patients were treated with VCR. Group 1 average age 7.7 +/- 3 years; BMI 17.7 +/- 2.8). Kyphosis averaged 85 degrees (70-150) and improved to 41 post op.(30-100). 50% (n=7) had intra-operative monitoring (IOM) changes that improved with corrective maneuvers and blood pressure elevation. 3 out of 5 patients with proximal junctional kyphosis (PJK) required a re-operation, one of whom also had additional procedure for infection.

Group 2 patients included Congenita-11 patients and Neurofibromatosis -2 patients. Average age: 17.8years; Sagittal deformity average 211deg and corrected to 53deg (74% correction). Intra-op spinal cord monitoring alerts occurred in 8 patients and post operative neurologic deficits occurred in 5 patients (1 permanent paraplegia) and 1 Post op mortality.

Conclusions: Severe kyphosis of congenital or Neurofibromatosis in early onset or adolescents patients can be safely treated with vertebral column resection. Prolonged Halo gravity traction is helpful to obtain partial deformity correction prior to definitive surgery. Surgery provides excellent outcomes but with a high complication rate. Half of these cases had some neuro-monitoring changes that ultimately improved without lasting neurologic deficit. Proximal junctional kyphosis was the most common complication requiring reoperation among the early onset group of patients.

INTRODUCTION

The Spine has a normal kyphotic curvature in the thoracic region extending measuring between 20 to 45 degrees. Kyphosis of 50 degrees or more in the thoracic spine is considered abnormal, and any kyphotic deformity in the cervical, thoracolumbar and lumbar region is also abnormal and may involve the lumbar or occasionally the cervical spine.

The possible causes of abnormal kyphosis

Postural, Scheuermann's disease, Congenital, Infections (predominantly Tuberculosis which has a relatively higher incidence in underdeveloped nation), Post-Trauma and

metabolic deficiencies. Severe kyphosis exceeding 100 and 180 degrees are most likely due to congenital or Neurofibromatosis malformation.

Patients usually present with back pain localized to the apex of the deformity or in the compensatory hyper-lordotic lumbar spine. The commonest complaint is increasing deformity, difficulty breathing and weight loss. It is well known that 75% of all congenital deformities will progress and surgical treatment is the mainstay of treatment, which can take the form of in situ stabilization to vertebral column resection [1-4]. For severe deformities exceeding 100 degrees regardless of the apex a resection procedure is the treatment of choice to decompress the

cord, correct the deformity and restore self image and function [3-5].

The literature is sparse when it comes to managing complex and severe kyphotic deformities in the underserved regions where resources are limited. The purpose of this report is to assess the surgical treatment outcomes and complications of 20 pediatric patients treated at a single site in West Africa with Halo gravity traction and vertebral column resection for severe kyphosis resulting from congenial and neurofibromatosis origin.

METHODS

Between 2012 and 2016 twenty early onset and adolescent patients with severe kyphotic deformities were treated with Halo gravity traction and Vertebral column resection at the FOCOS orthopedic hospital in Ghana West Africa. Patients' reviews included the following demographic and clinical data: age, gender, BMI, diagnosis, procedure, intraoperative monitoring events (IOM) events, intra and post op complications. Pre operative pulmonary function was obtained in patients over the age of 6 who could cooperate with the study. Pre operative Halo gravity traction (HGT) was performed in all the patients and consisted of applying 20% body weight initially and increased by 10% weekly to a maximum of 50% body weight in 4 weeks and maintained for several weeks depending on BMI, PFT and curve correction in traction. Patients were in traction full time except for eating and hygiene. HGT was discontinued when no improvement in curve magnitude was recorded on two consecutive 4 week intervals. The etiology, ASA classification and pre-op neurologic status were recorded. All patients were scored using the FOCOS risk stratification scoring system. FOCOS Score ranges from 0 to 100 with corresponding FOCOS Levels (FL, range 1-5) and are assigned using 20point FS (e.g., FOCOS 1: 1-20 ...5: 80-100). Higher scores/level denote increased risk. Scores include patient factors (PtF), Procedure factors (PcF) and Curve magnitude (CM) (Figure 1). Surgical treatment consisted of posterior fusion, vertebral column resection and segmental instrumentation. Detailed preoperative, Intraoperative and post operative data were collected to include patient demographics, Co-morbidities, surgical details, intraoperative spinal cord monitoring changes, Post operative neurologic function and any major complications occurring in the early post operative phase (3 months). Complications included mortality, neurologic deficit, blindness, and infection. The estimated blood loss and surgical time was available for all patients. Radiographic studies included 36 inch standing antero-posterior and lateral radiographs obtained pre-op, post traction, immediate post op and at follow up. The radiographic parameters evaluated included the coronal and sagittal deformity.

RESULTS

Twenty patients were grouped into early onset cases (Group 1) (average age 7.7 +/- 3years; BMI 17.7 +/-2.8) and adolescents and young adults (Group 2), average age 17.8years (11.6-24.6yrs). The etiologies were Congeintal (Group 1, N=7/Grp 2, N=11) and neurofibromatosis (Grp 2, N=3). All the patients in both groups were stratified as FOCOS level 5 placing them in the highest risk score category.



Figure 1 Pre and post operative Radiographs and clinical photos of 10 year old female with congenital Kyphosis treated with Posterior vertebral column resection and fusion with segmental instrumentation.

Group 1

Kyphosis improved from preoperative average of 85 degrees (70-150) to 41 degrees post op and compensatory lordosis from 56 degrees to 38 degrees post op. The estimated blood loss was 860ml +/- 520ml. Intraoperative neuro monitoring (IOM) changes improved with corrective maneuvers and blood pressure elevation. 3 out of 5 patients who developed proximal junctional kyphosis postoperatively required a reoperation. One of these patients also had additional procedures for infection. There was no mortality in this early onset group of patients.

Group 2

4 patients had pre operative neurologic deficits including one with severe myelopathy. The Halo gravity traction was maintained for an average of 110 days before definitive surgery. Similarly patients were operated on in Traction. The estimated blood loss for this group were 1985ml (1200-3000ml) (Figure 2).

All patients underwent a vertebral column resection posterior fusion and segmental instrumentation. One patient had a second staged anterior structural cage augmentation due to poor fitting during the posterior approach.

Pre operative coronal vertebral transposition averaged 75% (27% - 100%) and was fully corrected in all cases post op. Sagittal vertebral transposition and kyphosis averaged 211deg (184-241deg). Halo gravity traction improved the sagittal deformity by 36% and was corrected to an average of 53deg (74% correction) post operatively. A compensatory thoracic lordosis occurred in all the patients averaging -42 degrees (-7 to -107) and was corrected to a physiologic thoracic kyphosis average of 53 degrees (27-100 degrees) post operatively. Lumbar lordosis averaged -96 degrees (68-111deg) and improved to Avg 59 degrees (17-90 deg) post op. One patient was fused to L4 and developed post op distal junctional Kyphosis (DJK) that was revised with extension the sacrum. Intra-op spinal cord monitoring alerts occurred in 8 patients (61.5%) and post op neurologic deficits occurred in 5 patients (38.5%). One patient developed post op paraplegia with no improvement after 8 months. The patient also had proximal and distal junctional kyphosis that did not require treatment. The other patients with pre op neurologic deficits all improved

post op. There were no infections in this series. There was one mortality in a patient who developed cardio-pulmonary arrest in the immediate postoperative period and failed resuscitation.

DISCUSSION

Spine deformities especially kyphosis can occur in all age groups and nationalities. Pediatric patients are more prone to progressive deformities due their young age and potential growth. We categorized the patients into early onset (before age 10years) and adolescent to young adult to differentiate the prognostic difference in deformity and treatment outcomes.



Figure 3 A teenage patient with congenital kyphosis and vertebral transposition (Gamma deformity) exceeding 180 degrees treated the Halo gravity traction, Vertebral column resection and fusion.

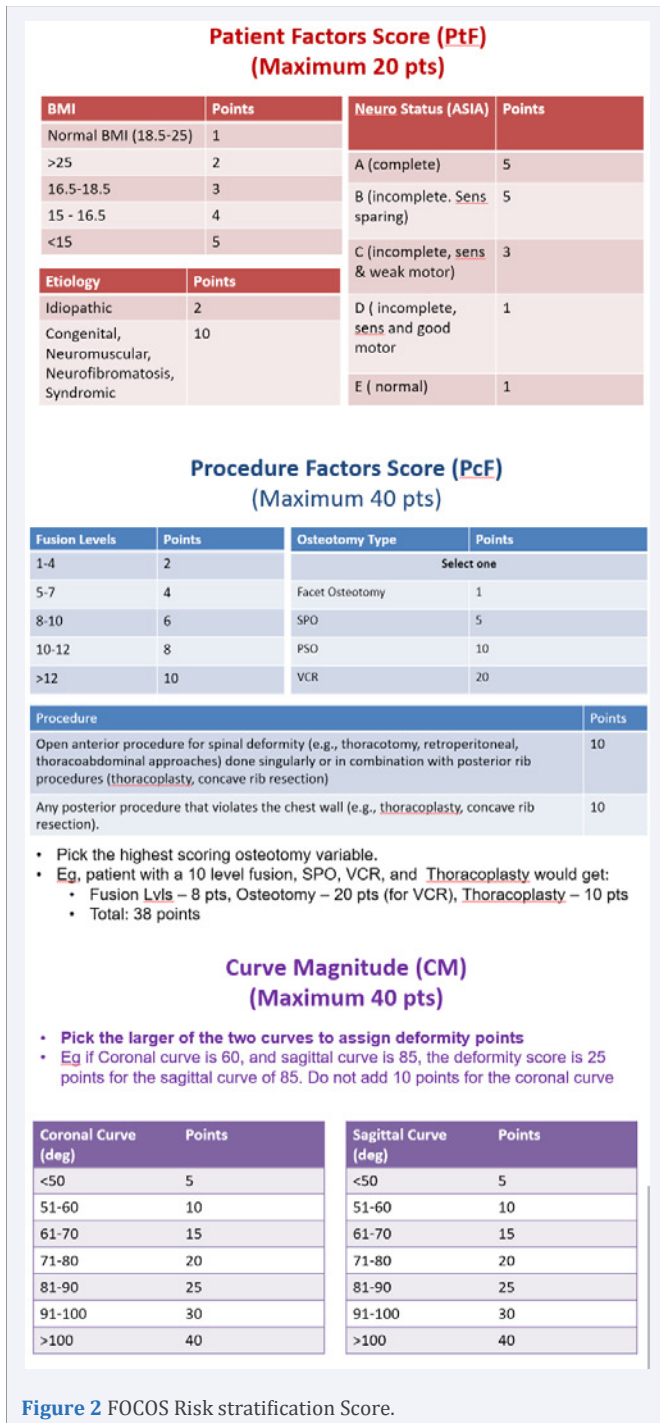


Figure 2 FOCOS Risk stratification Score.

Deformities exceeding 180 are very rare and seldom reported (Figure 3). Such severe kyphosis resulting from congenital and neurofibromatosis are progressive deformities that require surgical intervention. Complications arising from them include pulmonary function deficit, weight loss, neurologic impairment and early death [6]. Surgical treatment is the mainstay of treatment for these deformities and requires expertise and comprehensive perioperative care program for a successful outcomes. We have used the FOCOS surgical risk stratification score to categorize patient risk factors and try to mitigate the risk by improving patient factors such as BMI with nutritional optimization, curve magnitude by way of prolonged Halo gravity traction [6,7]. With the reduction in curve magnitude pulmonary function may also improve to facilitate post op medical recovery.

Posterior vertebral column resection has been proven to be an effective technique to provide a successful correction of stiff complex/rigid deformities. However, it is a technically demanding procedure, with high blood loss, operative time. High complications, [4-7] A multicenter study of 147 consecutive pediatrics who underwent 3 column Osteotomy procedures demonstrated excellent radiographic correction and improved clinical outcomes in pediatric patients with severe spinal deformities [8,9]. However, a 59% overall complication rate was reported, including neurologic sequelae both related to spinal cord monitoring and actual spinal cord and nerve root deficits.

In this series we showed that the application of long-termhalo gravity traction works best to partially correct the complex deformities while monitoring the patient’s neurologic status. The prolonged period of traction also serves to stretch the contracted soft tissues and the spinal cord. In effect the cord gets trained to tolerate the stretch imposed on it but in a gradual fashion. The natural history of curves over 180 is unknown. We have seen a couple of patients (not in this series) who presented in their late teens and early adult years with paralysis which implies that there is a threshold point at which the cord is over stretched resulting in vertebral column instability (dislocation). Unfortunately in underserved regions where there is limited resources and facilities to manage such deformities, patients with these conditions will meet this unfortunate fate unless here is a national campaign and intervention program to detect and treat them early. The FOCOS hospital program has been established

to address these complex deformities with successful outcomes [6,10,11].

CONCLUSION

Complex and severe kyphotic deformities present a great challenge to the treating surgeon and medical team. A multidisciplinary approach is needed to optimize perioperative outcomes of these high risk patients. Vertebral column resection with or without Halo gravity traction proves excellent radiographic and clinical outcomes, despite the high complication rate.

REFERENCES

1. Smith JT, Gollogly S, Dunn HK. Simultaneous anterior-posterior approach through a costotransversectomy for the treatment of congenital kyphosis and acquired kyphoscoliotic deformities. *J Bone Joint Surg Am.* 2005; 87: 2281-2289.
2. Ozturk C, Alanay A, Ganiyusufoglu K, Karadereler S, Ulusoy L, Hamzaoglu A. Short-term X-ray results of posterior vertebral column resection in severe congenital kyphosis, scoliosis, and kyphoscoliosis. *Spine (Phila Pa 1976).* 2012; 37: 1054-1057.
3. Xie J, Wang Y, Zhao Z, Zhang Y, Si Y, Yang Z, et al. One-stage and posterior approach for correction of moderate to severe scoliosis in adolescents associated with Chiari I malformation: is a prior suboccipital decompression always necessary? *Eur Spine J.* 2011; 20: 1106-1113.
4. Kawahara N, Tomita K, Baba H, Kobayashi T, Fujita T, Murakami H. Closing-opening wedge osteotomy to correct angular kyphotic deformity by a single posterior approach. *Spine (Phila Pa 1976).* 2001; 26: 391-402.
5. Zhang Z, Wang H, Shangguan L. Posterior 2-Level Vertebral Column Resection for the Treatment of Progressive Rotational Dislocation in Kyphoscoliotic Deformities. *World Neurosurg.* 2016; 88: 428-432.
6. Oheneba Boachie-Adjei, Mitsuru Yagi, Venu M. Nemani, Cristina Sacramento-Dominguez, Harry Akoto, Matthew E. Cunningham, et al. Incidence and Risk Factors for Major Surgical Complications in Patients With Complex Spinal Deformity: A Report From an SRS GOP Site. *Spine Deformity.* 2015; 3: 57-64.
7. Venu M. Nemani, Han Jo Kim, Benjamin T. Bjerke-Kroll, Mitsuru Yagi, Cristina Sacramento-Dominguez, Harry Akoto, et al. Preoperative Halo-Gravity Traction for Severe Spinal Deformities at an SRS-GOP Site in West Africa Protocols, Complications, and Results. *SPINE.* 2015; 40: 153 – 161.
8. Auerbach JD, Lenke LG, Bridwell KH, Sehn JK, Milby AH, Bumpass D, et al. Major complications and comparison between 3-column osteotomy techniques in 105 consecutive spinal deformity procedures. *Spine (Phila Pa 1976).* 2012; 37: 1198-1210.
9. Lenke LG, Newton PO, Sucato DJ, Shufflebarger HL, Emans JB, Sponseller PD, et al. Complications after 147 consecutive vertebral column resections for severe pediatric spinal deformity: a multicenter analysis. *Spine (Phila Pa 1976).* 2013; 38: 119-132.
10. Sacramento-Domínguez C, Yagi M, Ayamga J, Nemani VM, Akoto H, Mahmud R, et al. Apex of deformity for three-column osteotomy. Does it matter in the occurrence of complications? *Spine J.* 2015; 15: 2351-2359.
11. Papadopoulos EC, Boachie-Adjei O, Hess WF, Sanchez Perez-Grueso FJ, Pellisé F, Gupta M, et al. Early outcomes and complications of posterior vertebral column resection. *Spine J.* 2015; 15: 983-991.

Cite this article

Boachie-Adjei O, Yankey K (2017) The Use of Halo-Gravity Traction and Vertebral Column Resection to Treat Children with Severe Kyphosis. Results and Complications. *Ann Pediatr Child Health* 5(3): 1129.