A Retrospective Review of Patient Outcomes Following Halo-femoral Traction before Spinal Instrumentation in the Management of Severe Scoliosis and Kyphoscoliosis

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ABSTRACT

Objective: To determine the effectiveness of peri-operative halo-femoral traction in the management of severe scoliosis and kyphoscoliosis - A retrospective review.

Methods: The case notes for 94 subjects with severe scoliosis and kyphoscoliosis were studied from 1973 to 2012 from Princess Elizabeth Centre Trinidad, West Indies. The notes studied were based on hospital records, standing pre-operative antero-posterior (AP) radiographs, post traction radiographs, immediate post operative AP x-rays and one year follow up x-rays. The primary outcome measure was coronal curve correction (Cobb's angle) immediately post operatively after patients received halo-femoral traction. Other endpoints were intra-operative time and blood loss, coronal curve at one year and postoperative complication rates. All statistical analyses were conducted using SPSS Inc. statistics for windows version 17.0 Chicago SPSS Inc.

Results: Subjects were analyzed by age at date of surgery (range 11- 37 years, mean 17 years), gender (80.9% females, 19.1% males), major coronal curve magnitude (range 60 – 130 ^{0}, mean 87^0), duration of traction (range 6 – 21 days, mean 12 days), types of instrumentation, intra-operative time (range 1.34 – 8.75 hours, mean 3.67 hours), intra-operative blood loss (range 263 – 3259 ml, mean 1190 ml), coronal curve correction post operatively (range 20- 100^0, mean 47^0) and at 1 year follow up (range 25– 80 ^{0}, mean 52^0). The commonest post operative complication was hardware migration (8.5 %).

Conclusion: The management of severe scoliosis continues to be difficult due to its multi-planar presentation. A useful adjunct to the spinal surgeon's arsenal against major curves is halo-femoral traction. When combined with spinal instrumentation and fusion, this treatment protocol is proven to be safe, tolerable and effective in our local setting.

Keywords: Halo-femoral traction, retrospective, scoliosis

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INTRODUCTION

The instrumentation utilized in scoliosis correction has evolved over the last several decades (1)(2). The insidious nature of this spinal pathology encouraged the advent of international scoliosis screening programs (3). Locally we depend on the district health visitor, parents, community doctors or the patients' themselves to detect any spinal deformity. An investigation of a specific population of subjects in Trinidad and Tobago using moiré topography estimated an incidence rate of 0.2% after secondary screening in the Princess Elizabeth Home (PEH) (4).

Scoliosis is defined as a lateral curvature of the spine greater than 10 degrees accompanied by vertebral rotation (5). It is a multi-planar spinal deformity characterized by a lateral curvature in the coronal plane, lordosis in the sagittal plane and rotational abnormality in the axial plane (6). Curve magnitude is a risk factor for curve progression (5-11). The measurement of Cobb's angle in the coronal plane after x-ray AP (antero-posterior) or PA (postero-anterior) imaging determines curve size (12). A severe curve that is allowed to progress can eventually result in serious morbidity and may even cause death (13) (14).

Spinal instrumentation and fusion is typical in the surgical treatment of severe scoliosis as it enhances fusion and caters for deformity correction (1)(2). A useful adjunct to posterior spinal instrumentation for deformity correction is halo-femoral traction (15-19). However surgery is sometimes accompanied by its associated complications. These include bleeding, infection, nerve injury, progression of deformity, pseudo-arthrosis and deep vein thrombosis (DVT) (1). These potential complications are reduced by anaesthetic and surgical principles and techniques (1)(20).

The aim of this study is to retrospectively analyze the case records and radiographs of severe scoliosis patients treated with peri-operative halo-femoral traction before spinal instrumentation to determine its effectiveness. To date there is no similar study done in the West Indies.

METHODS

Study design and Population

We carried out a retrospective analysis of patients' records and radiographs following Halo-femoral traction and spinal instrumentation and fusion procedures performed at Princess Elizabeth Centre, Trinidad from January 1st 1973 to December 31st 2012. Ninety-four patients forming one large case series formed the sample. Patients were excluded if they had not undergone halo-femoral traction before surgery. The data was collected in the surgical out-patient department of the PEH. The consultant who performed the surgeries was not involved in data collection or analysis.

Details of retrospective review

The case notes for aforementioned subjects with severe scoliosis and kyphoscoliosis were studied. The notes studied were based on hospital records, standing pre-operative antero-posterior (AP) radiographs, post traction radiographs, immediate post operative AP x-rays and one year follow up x-rays. The primary outcome measure was coronal curve correction (Cobb's angle) immediately post operatively after patients received halo-femoral traction. Other endpoints were intra-operative time and blood loss, coronal curve at one year and post operative complication rates.

Statistical Analysis

All statistical analyses were conducted using SPSS Inc. statistics for windows version 17.0 Chicago SPSS Inc.

Ethical approval

Consent was waivered and permission was obtained from the institutional review board before this project was performed.

RESULTS

The case series consisted of 94 subjects. The mean age at surgery was 17 years (11, 37; SD 4.5) and females predominated 18.1% (76) the males 19.1% (18). The commonest diagnosis encountered was adolescent idiopathic scoliosis 79.8% (75) followed by neuromuscular 14.9% (14), congenital 2.1% (2), syndromic 2.1% (2) and adult scoliosis 1.1% (1). (Refer to Table 1 for Baseline characteristics)

Harrington rod and hook system 68.1% (64) outweighed the other generations of spinal instrumentation. The other instruments included bilateral rod and pedicle screws 29.8% (28) and anterior cable and screws 1.1% (1). The average time spent on halo-femoral traction was 12 days (6, 21; SD 2.3). The mean intra-operative time was 3.66 hours (1.33, 8.75; SD 1.48). Intra-operative blood loss averaged 1190 milliliters (263, 3259; SD 558). (Refer to Table 2 for Intra-operative results)

The average major pre-operative coronal curve magnitude was 87^0 (60^0, 130^0, SD 13^0). The mean post traction curve was 58^0 (20^0, 100^0; SD 17^0) and the mean coronal curve

immediately post operatively was 47^0 (20^0, 100^0; SD 16^0). At 1 year follow up the mean coronal curve was 52^0 (25^0, 80^0; SD 12^0).

The mean correction after halo-femoral traction was 29^0 (33%). The mean immediate post operative coronal curve correction was 40^0 (46%). There was a loss of correction 1 year post operatively averaging 5^0 (0.1%).

The commonest postoperative complication was hardware migration 8.5 % (8). This was followed by wound infection 5.3% (5), temporary neurologic injury 3.2% (3), curve progression necessitating revision surgery 2.1% (2), deep vein thrombosis/DVT 2.1% (2) and finally crankshaft phenomenon and excessive bleeding 1.1% (1). (Refer to Table 3 for primary and secondary outcomes)

DISCUSSION

The main findings were as follows, first the major coronal pre-operative curve was 87^0 in our series. The average curve correction after halo-femoral traction was 29^0 (33%). Second, after halo-femoral traction, spinal instrumentation and fusion the mean post operative curve was 47^0. The average coronal correction post operatively was 40^0 (46%). Third, at 1 year follow up, the mean post operative curve measured 52^0. There was a 5^0 (~0.1%) loss of correction at this point of time. Fourth, the commonest complication encountered in this study was hardware migration 8.5% (8 patients). There were no cases of permanent neurological injury or deaths occurring in this review.

A retrospective study done by Sink E et al (2001) reported an average major curve of 84^0 and post operative correction after halo-femoral traction of 35% (18). Our retrospective study yielded similar results with respect to thoracic coronal curve correction. Another retrospective

study by Zhu ZZ et al (2010) also had comparable post traction and instrumentation rates of 48.6% in the coronal plane (16). Yet another retrospective study by Rinella A et al (2005) reported a coronal curve correction of 46% (38^0) (15). Our study was larger (94 patients) than all the aforementioned reports' (33 patients or less).

The mean halo-femoral correction rate was 13.2% in the study done by Zhu ZZ et al (2010) (16). Our study showed an almost 3 fold increase in halo-femoral correction rate of 33%. We utilized halo-femoral traction for 12 days on average. Park DK et al (2013) proved that the greatest effect of traction corresponded to 14 days (17). A prospective cohort study by Zhang HQ et al (2012) had a significant mean intra-operative time of 5.1 hours and blood loss of 1756 ml (19). We reported a shorter mean operative time of 3.66 hours and a decreased blood loss of 1190 (approximately 600 ml less).

Our follow up period was less than that of the study by Rinella A et al (2005), 12months compared to 44months with a comparable average loss of correction of 5^0 compared to 7^0 respectively (15). No permanent neurological injury occurred in studies performed by Rinella A et al (2005) , Zhu ZZ et al (2010) , Zhang HQ et al (2012) as well as in our review (15) (16) (19).

The strengths of this study included the large sample size and the proven benefits of halo-femoral traction as an adjunct to major coronal curve corrective surgery (rigid scoliosis curves measuring > 80^0).

Limitations included the study's retrospective nature, no assessment of flexibility, short follow up period (< 5 years) and no assessment of patient reported outcomes i.e. how surgery affected patients' quality of life.

This is the first study of its kind to be conducted in Trinidad in the field of orthopaedics. It justifies the efficacy and safety of peri-operative halo-femoral traction in the treatment of severe scoliosis in our population. It confirms the usefulness of adjuncts in scoliosis management together with sell saver techniques and need for spinal monitoring to further reduce complication rates.

The management of severe scoliosis continues to be difficult due to its multi-planar presentation. A useful adjunct to the spinal surgeon's arsenal against major curves is halo-femoral traction. When combined with spinal instrumentation and fusion, this treatment protocol is proven to be safe, tolerable and effective in our local setting. Surgeons should also be aware of complications of spinal instrumentation.

ACKNOWLEDGEMENTS

I would like to thank all the patients of Princess Elizabeth Home who participated in the study. Special thanks to clinic and theatre staff of PEH who made this study possible. I would also like to thank Dr. Kyla Thomas for useful comments on drafts of the manuscript.

AUTHORS' NOTE

This study had no sponsors. There are no conflicts of interest

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Table 1: Baseline characteristics of patients

	Mean	Range	SD	n	%
Age at Surgery	17	11,37	4.5		
Gender					
M				18	19.1
F				76	80.9
Diagnosis					
Idiopathic				75	79.8
Neuromuscular				14	14.9
Congenital				2	2.1
Syndromic				2	2.1
Adult				1	1.1
Total				94	100

SD- standard deviation, n – sample size, M – male, F - female

Table 2: Intra-operative results of patients

	Mean	Range	SD	n	%
Instrumentation :					
Harrington rod and hook				64	68.1
Bilat. rods and pedicle screws				28	29.8
Anterior rods and cables				1	1.1
Other				1	1.1
Duration of traction (days)	12	6, 21	2.3		
Intra-operative time (hours)	3.66	1.33, 8.75	1.48		
Intra-operative blood loss (ml)	1190	263, 3259	558		

SD- standard deviation, n – sample size, Bilat.- bilateral

Table 3: Primary and secondary outcome measures

	Mean	Range	SD	n	%
Pre-op major curve(degrees)	87	60, 130	13.2		
Post traction curve	58	20, 100	17.3		
Immediate post op curve	47	20, 100	16.3		
1 yr post op curve	52	25, 80	12.3		
Complications:					
Hardware migration				8	8.5
Infection				5	5.3
Nerve Injury				3	3.2
DVT				2	2.1
Progression/ revision surgery				2	2.1
Crankshaft phenomenon				1	1.1
Excessive bleeding				1	1.1

Pre/post op – pre/post operative, DVT – deep vein thrombosis

Table 4: Curve correction or loss after halo-femoral traction and spinal instrumentation

	Mean Correction	
	Angle ^{0}	%
Post Halo-femoral traction	29	33
Immediately post op surgery	40	46
1 year post op surgery (loss)	5	~ 0.1

Loss- loss of curve correction, post op – post operative