SPINAL SHORTENING PROCEDURES

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ABSTRACT :

Correction of deformity produces elongation of the neural canal. The most common method of correction in up to date instrumentation involves distraction, strong corrective force but also the cause of multiple complications. Correction at the apex, and alignment of the ends of the curve as in translation lever arms, and transverse traction, avoids elongation of the neural cord, and decompensation of the corrected spine.

Key words : *spine deformity, spinal shortening*

INTRODUCTION

Scoliosis is a dimensional deformity that varies from vertebra to vertebra, (it is segmental in the A-P, Lat., sagittal, and around its own axis). Correction of scoliosis can only be obtained by correcting the spine and other structures secondarily deformed with it, e.g.: The pelvis, the thoracic cage, the sternum, the scapula, the clavicle, and all soft tissues there at.

Correction of all structural deformity must be accomplished in reverse manner to which the pathology was created: Apical vertebra rotation and angulation by shortening procedures, then, alignment of the flexible ends of the curve finally correction of the paravertebral structures (Fig. 1, 2, 3, 4).

MATERIAL

108 cases were studied after a follow-up ave. of 3.2 yrs. no case had less than 2 yrs. F.U., the oldest 19 yrs. F.U. There were 68 females and 40 males. The age ranged from 5 yrs. to 22 yrs. ave. 14.3 yrs.

The diagnosis were:	Idiopathic Scoliosis	48
	Juvenile	11
	Congenital Scoliosis	29
	Neuromuscular Scoliosis	20

The deformity in conventional 2 Dimensional measurements were: AP Ave. 81°, from 44° to 168° Cobb. Lat. thoracic minus 20° ave. from plus 100° to minus 20°. In the lumbar area from minus 10° to plus 60°, ave. 45°.

INSTRUMENTATION

Instrumentation, SSI or derivatives from 19 yrs. up to 4 yrs. FU and GDLH for all recent patients 4 yrs. to 2 yrs. F.U.

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METHOD AND TECHNIQUE

All cases had shortening procedures at the apex of the curve: Discectomies, vertebrectomies, laminectomies wedge osteotomies, costectomies, scapulectomies, etc., to obtain a (4D) balance of the body deformity (not necessarily correspondent to the spine deformity), all were carried out during instrumentation, as needed.

108 patients had posterior lateral arthrodesis and segmental instrumentation. 39 cases had anterior procedures as well.

No distraction over the entire curve was used, as a result no over all elongation was provoked.

Spinal translation, segmental lever arm correction, derotation Dubousset style, and segmental distraction, (within the deformity), lever arm alignment, transverse traction, convex segmental compression, were some of the usual forces used, all under fixed length of correction (Costectomies, reconstruction of the thoracic cage, both concave and convex, and other auxiliary periaxial corrections). Pelvic obliquity and rotational deformities were treated with soft tissue and bony skeleton releases and alignment (Fig. 5, 6, 7, 8).

Ancillary Procedures

Costectomies usually multiple, were done on the convex side, to reconstruct the thorax cage Transverse process extirpation as part of the reconstruction of the thoracic cage and soft tissue releases were done as necessary. Lengthening procedures of shortened or contracted structures were also done usually on the concave side. In severe kyphosis deformties severing of the anterior longitudinal ligament was needed. In Scoliosis cases, severing the yellow ligaments as well as intervertebral posterior ligaments permitted better segmental correction.

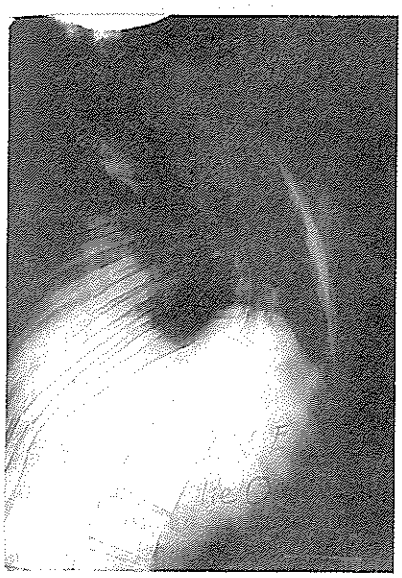

Fig. 1: AP of Scoliosis deformity in the thoracic area of Idiopathic origin in a female, age 25 yrs. Cobb 106°, FU 2.5 yrs.

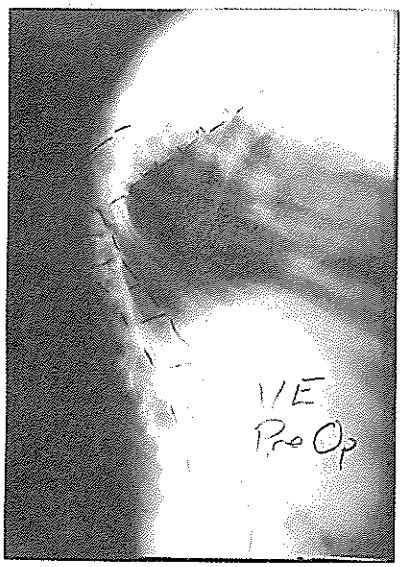

Fig. 2: The same patient of Lateral view upright, thoracic kyphosis of 92°.

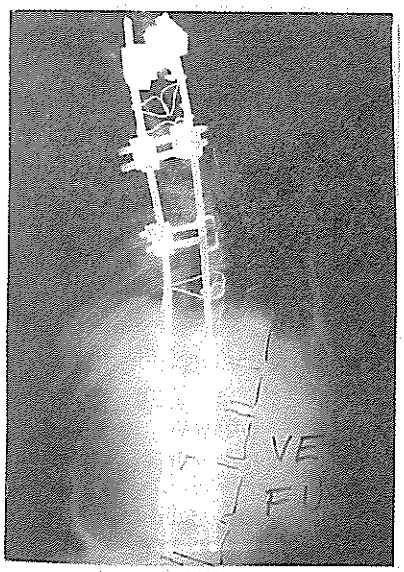

Fig. 3: Three yr. Post op. after anterior discectomies from T12 to T4 and corpectomies at T9-T10. Reconstruction of the thoracic cage by costectomy on the convex side in rib. Osteotomy on the concave side. Correction obtained by translation of the apex on the corpectomy level and the aligning the flexible ends over the corrected apex. Cobb angle of 36°.

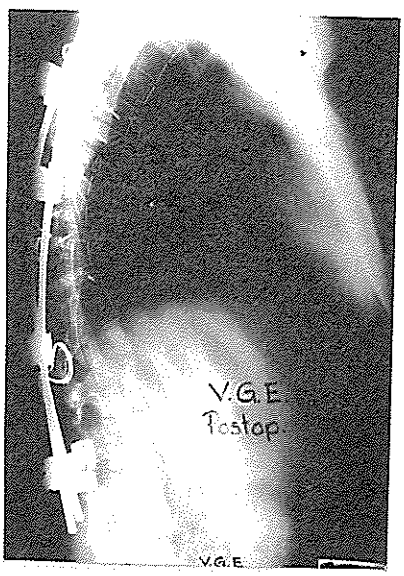

Fig. 4: Lateral of the same pt. Post op. 1 yr. Correction of the Kyphosis by lever arm action by bringing the spine to rod via uprights of the end claw hook formation.

COMPLICATIONS

There were three pseudoarthrosis, all rearthrodesed without loss of correction. Six cases with loss of correction of more than 10%. Five of these cases with unacceptable clinical results. There were no lasting neurological complications; in the immediate post op. three patients had diminished strength in one extremity and other three patients had transient paresthesias.

In seven patients heavy bleeding occurred without long term complications (more than 2000cc). Four patients had minor post op. medical complications without significance. There were five cases with superficial infections that were cured with soap and water, five others needed debridement, antibiotics and a secondary closure.

RESULTS

Clinical results were graded on a scale of 0 to 10 taking in consideration the patient, family members, and the physician. Excellent results were obtained in 33 cases, good results were obtained in 59 cases. Fair results were obtained in 11 cases. Poor results were obtained in 5 cases.

In two dimensional measurements the A-P was corrected by an Ave. of 67% from 85% to 48%. Of the five poor results, three were out of balance.

DISCUSSION

Shortening procedures or destruction of the deformity at the apex of the curve, permitted correction at the most rigid part of the pathology 15° to 30° per segment, according to whether a simple laminectomy and concave release was done, or a vertebrectomy; When multiple shortening procedures were done, these all contributed to the correction in a similar manner.

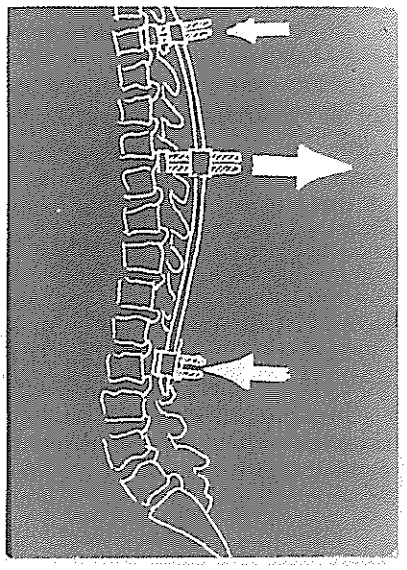

Fig. 5: Correction of thoracic lordosis by translation bringing the spine to the rod by mechanical action of the hook uprights.

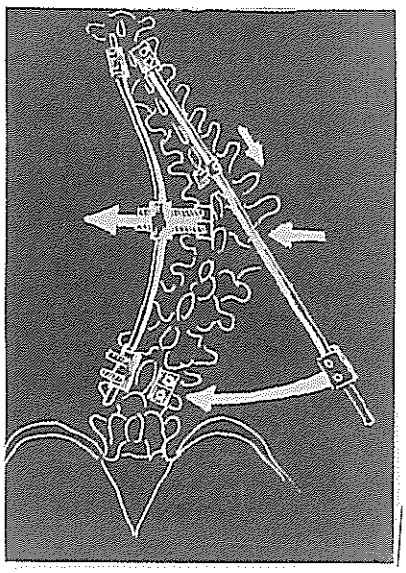

Fig. 6: Translation of tha apical vertebra on the concave side on a pre molded rod. Dynamic lever arm on the convex side with minimal molding. As apex is brought by translation and derotation on the concave rod, convex rod alines the ends of the curve.

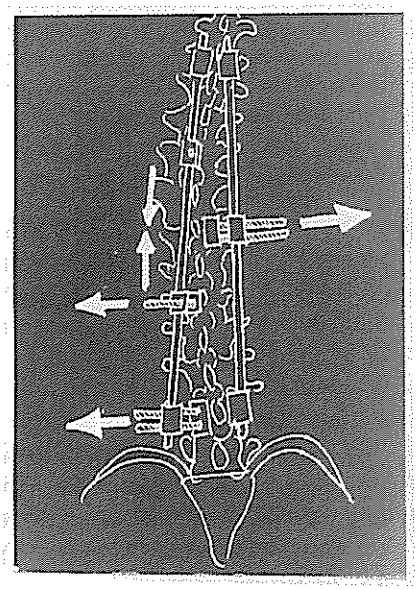

Fig. 7: Double curved instrumentation with claw hooks above and below at the ends of the curve, producing translation forces at the apex of the curves and compression forces on the convex side.

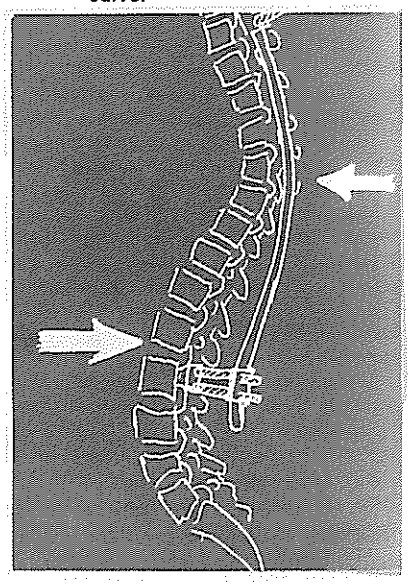

Fig. 8: Correction of Kyphosis using the rod on the convex side by using the instrumentation as snug to the vertebral lamina and then producing a translation force, bringing the spine to the rod at the cord of the deformity.

Collapsing the apex provoked not only correction but also the possibility of derotating one segment of the spine on the other.

When a vertebrectomy is done, one segment of the spine can be rotated in relation to the other, so that half of the deformity will lay in neutral rotation (Fig. 9, 10, 11).

The use of lever arm alignment with the molded bars will facilitate balance both in the A-P and lateral planes. Bringing the spine to the rod (transverse traction) will not only correct in an A-P plane but will apply segmental derotational forces and will correct kyphosis and lordosis with a shortening procedures at the apex, eg.: vertebrectomy.

To facilitate correction, we used vertical traction on the concave apical rib while instrumenting the spine, this translates the thoracic cage around the vertebral column axis and permits 4D collapsing at an apical vertebrectomy sight. The ends of the curve are aligned above and below the corrected apex.

In a pre set length by using claw hooks at each end of the deformity, correction must be obtained by compression on the convex side of the affected intervertebral discs and distraction on the convex side as the last corrective force.

Segmental distraction and compression were used sparingly: One to give further stability (Fig. 12) to the deformity or, to gain additional segmental correction and alignment.

Correction of collateral structures, e.g.: thoracic cage, scapula alata, pelvic rotation or obliquity were done in the same procedure and all added to align and correct the spine. Removed rib segments were used as bone graft.

Concave costectomy at the apex of the curve was done in severe de-

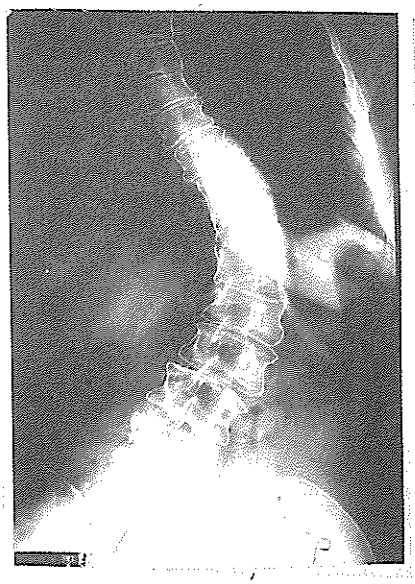

Fig. 9: A dorsal lumbar curve L4 to T6 Idiopathic origin. 36 yrs. old lady. Notice the translation rotation deformity between L1 and T12. Cobb angle 63°.

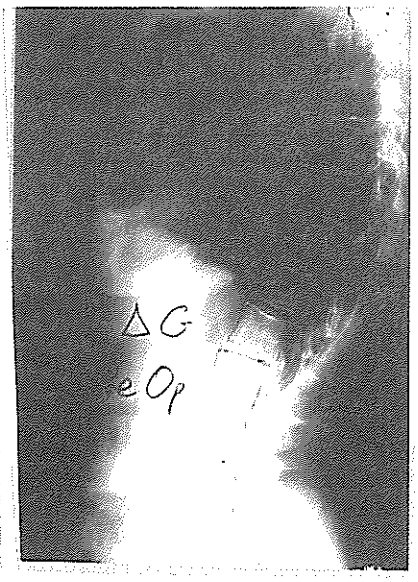

Fig. 10: Lateral X-ray of the same patient showing decrease Lordosis.

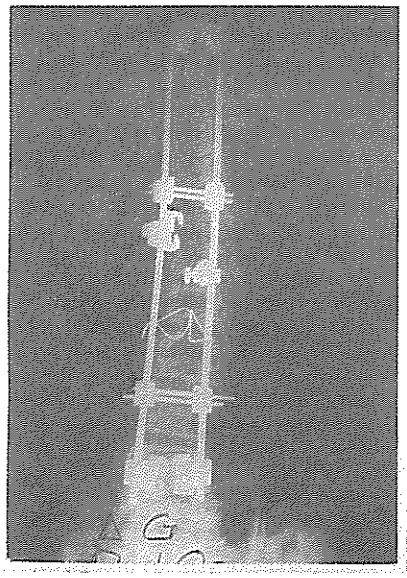

Fig. 11: AP correction 3 yrs. Post op. corrected after shortening procedure at T12 derotation of one segmental of the spine in relation to the others. Apical translation and compression.

Fig. 12: Follow up lateral X-ray, notice physiological curves included.

formity to release the rotational buttress and permits apical correction. .

The absence of complications trans operatively was attributed to sequential progressive alignment and correction under strict control, bringing the spine to the rod. All patients were monitored pre, during, and post surgery.

In this serie of patients, there is the evolution of SSI technique (patients with more than 4 yrs. F.U.) to the more refined GDLH technique (patients with 2 to 4 yrs. F.U.) that substitutes hooks for wires permits controlled length of the spine by double hooks at each end of the curve, and a millimetrical controlled correction as the spine at the apex is brought to the rod by mechanical means, via the threaded uprights of the hooks gives rotational, partial correction with a maximum of safety.

Correction by shortening has been simplified to be applicable in most cases of Scoliosis.

The concept of correction of the thoracic cage and pelvis has been a consequence of the esthetics demands of patients, that are not necessarily satisfied with an only straight flat spine.

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