

THE INTRODUCTION OF COLORADO INSTRUMENTATION TO MANAGE VERTEBRAL DEFORMITIES*

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ABSTRACT :

Fifty-four patients, with vertebral deformities, treated with Colorado instrumentation were studied before and after surgery. To evaluate the features of a new surgical instrumentation, the Colorado system, chosen after investigating the most recent techniques. A 3D approach is fundamental in the surgical management of spinal deformities; in particular, when treating scoliosis, surgeons have to aim at a correction on frontal plane, as well as at restoring physiological thoracic kyphosis and lumbar lordosis. As of the 80s, new vertebral instrumentations, such as CD, have been based in part on these concepts. At present, new instrumentations have been set up, like Colorado, able to ensure a frontal-sagittal correction in an easier and more effective way. We have reviewed the clinical records of 54 patients affected by severe vertebral deformities and treated surgically. All patients were reviewed at regular intervals with mean follow-up of 10 months (range, 4 to 20 months). At follow-up examination every patient underwent subjective, objective and X-ray evaluations. In patients with idiopathic scoliosis, the mean improvement was equal to 54.7% in adolescent group and equal to % in adult group. In patients with neuromuscular deformities the mean improvement was equal to 49%. In cases with congenital kyphoscoliosis the mean correction was equal to 32% for scoliosis and equal to 56% for kyphosis. No complications occurred during surgery. There was a mild postoperative loss of correction in 3 cases with idiopathic scoliosis, that was unchanged at follow-up. The peculiar mechanical features of the Colorado system, which has proved to be very easy to apply, offer a new way to correct and stabilize any type of deformity.

Key words: vertebral deformity, scoliosis, instrumentation

INTRODUCTION

A 3D approach is fundamental in the surgical management of spinal deformities; in particular, when treating scoliosis, surgeons have to aim at a correction on frontal plane, as well as at restoring physiological thoracic kyphosis and lumbar lordosis. As of the 80s, new vertebral instrumentations, such as Cotrel-Dubousset (2, 3), have been based in part on these concepts. In fact, using CD instrumentation (2), correction was not achieved distracting the ends of the instrumentation, as it occurred with the Harrington, but mobilizing the deformity apex (derotation), by rotation of a pre-contoured rod (4). However, the principle of rotation could not ensure the expected results: the evidence of both good realignment on frontal plane and poor action on thoracic deformation and kyphosis led to more detailed biomechanical evaluations, thus reaching an explanation, to be summed up in the following concept; the rotation centre of a scoliotic de-

formity lies on a posterior axis, while the derotating action of a rod, fitted to the vertebrae, acts on the anterior axis (5). The derotation of the rod is performed without any particular problem by Colorado instrumentation, because it is not closely linked to the spine and it does not impose its rotation. Set up in France by Dr. D. Chopin and Dr. P. Roussouly, the Colorado technique represents an evolution of the new concepts outlined by Dr. Y. Cotrel and Dr. J. Dubousset in the 80s. It aims at a segmental and tridimensional correction and its peculiar features are more elastic rods, the possibility to pre-fix the rod to the hooks in an easy and provisional way and to obtain a further frontal and sagittal correction by final fixation. Moreover, the system is equipped with a special sacro-iliac plate, just conceived for the lumbo-sacral fixation.

METHODS

We have reviewed 54 patients, affected with spinal deformities, who underwent surgery by Colorado technique at our department from May '94 to September

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'95. They were 11 males and 43 females, ages 20.5 years on average (range, 9 to 58 years). All of the patients were reviewed at regular intervals with mean follow-up of 10 months (range, 4-20 months). The diagnosis included 37 idiopathic scoliosis, 10 spinal deformities secondary to neuromuscular disorder and finally 7 congenital kyphoscoliosis. The levels of instrumentation, the eventual postoperative complications, the hospitalization time and the need for external support were reviewed. At follow-up examination every patient underwent subjective, objective and X-ray evaluation. Because of the cross-section of spinal pathology included in this series, each group is discussed separately, to highlight differences in technique and result.

RESULTS

Idiopathic scoliosis Our report is based on 37 cases affected with idiopathic scoliosis: 27 were teenagers aged 15.7 years on average (range, 13 to 20 years) and 10 were adults aged 40.5 years on average (range, 32 to 58 years). From a radiographic point of view, deformities have been classified as follows: in the teenage group, King I in 8 cases, King II in 13, King III in 1, King IV in 2 and King V in 1; in the adult group, King I in 4 cases and King IV in 2 (3). Preoperative mean angular rate was 67° for the adolescents (range, 46° to 87°) and 81° for the adults (range, 50° to 100°). The setting of the instrumentation was performed at lumbar level with pedicular screws, except for 3 cases with laminar hooks. The superior stopping of the instrumentation was often made by pediculo-transversal or pediculo-laminar blocking. In all of the cases "evoked spinal cord potentials" were performed pre- and intraoperatively. Each instrumentation was associated with arthrodesis, by cruentation of posterior arches and articular processes, together with abundant homologous bone grafting. Mean surgery time was 3 hours. Postoperatively, adult patients wore a plaster cast until 45th day, then a brace till 4th month after surgery. Teenagers were placed in a brace for four months. In the adolescent group the average angular rate of scoliosis decreased to 31° (range, 8° to 60°), with a mean correction equal to 54.7%. In the adult group, postoperative mean angular rate was 49° (range, 28° to 80°), with a mean correction equal to 39%. The re-balancing on sagittal plane was constant (Fig. 1a, b, c, d).

Neuromuscular disorders 10 cases underwent surgery for neuromuscular disorders: they were 7 males and 3 females. Eight were teenagers, aged 12 years on average (range, 10 to 17 years) and 2 were adults, a woman aged 56. Three cases were affected with Duchenne myopathy, 6 with spinal muscular atrophy and one had suffered from an acute anterior poliomyelitis during his childhood. The curve site was lumbar in 5 cases and thoracolumbar in 5. The average scoliosis measured 95° preoperatively. The instrumented levels were 15 on average and in 8 cases the arthrodesis had been extended to the sacrum; in these latter cases pelvic obliquity was reduced from 88° to 62° (improvement 30%). The operation lasted 4 hours on average: mean blood losses were 2000 cc. Post-surgery a planned period in the intensive care unit was necessary for all of the patients. No patient required postoperative immobilization. The average scoliosis measured 63° postoperatively (improvement 49%). On average they were all discharged from hospital on the 10th day.

Congenital deformities We have reviewed 7 cases, presenting with congenital spinal deformities, aged 14 years (range, 9 to 17 years). From a radiographic point of view, deformities were classified as kyphoscoliosis. The site was thoraco-lumbar in all cases. Preoperative mean angular rate was 76° for scoliosis (range 50° to 128°) and 65° for kyphosis (range 22° to 134°). Four cases were instrumented using only the Colorado implant, while in 3 we associated also an anterior arthrodesis, at the apex of the kyphosis. The setting of Colorado instrumentation was performed at lumbar levels with pedicular screws. Postoperatively, all patients wore a plaster cast until 45th day, then a brace till 4th month after surgery. Postoperative mean angular rate was 51° for scoliosis (range 27° to 100°) with an improvement of 32% and 28° for kyphosis (range 6° to 50°) with an improvement of 56%.

COMPLICATIONS

No implications occurred during the operation. Immediately after surgery, no neurological and digestive complications, as well as no infections, arose. At follow-up, the angular result was unchanged in 31 cases. In 2 cases with idiopathic scoliosis (teenager, 1 King I and 1 King III), a loss of reduction equal to less than 10° was observed; in another case with idiopathic scoliosis (teenager, King I) a loss of 20° was registered at 3rd month, but was unchanged at 12th month.

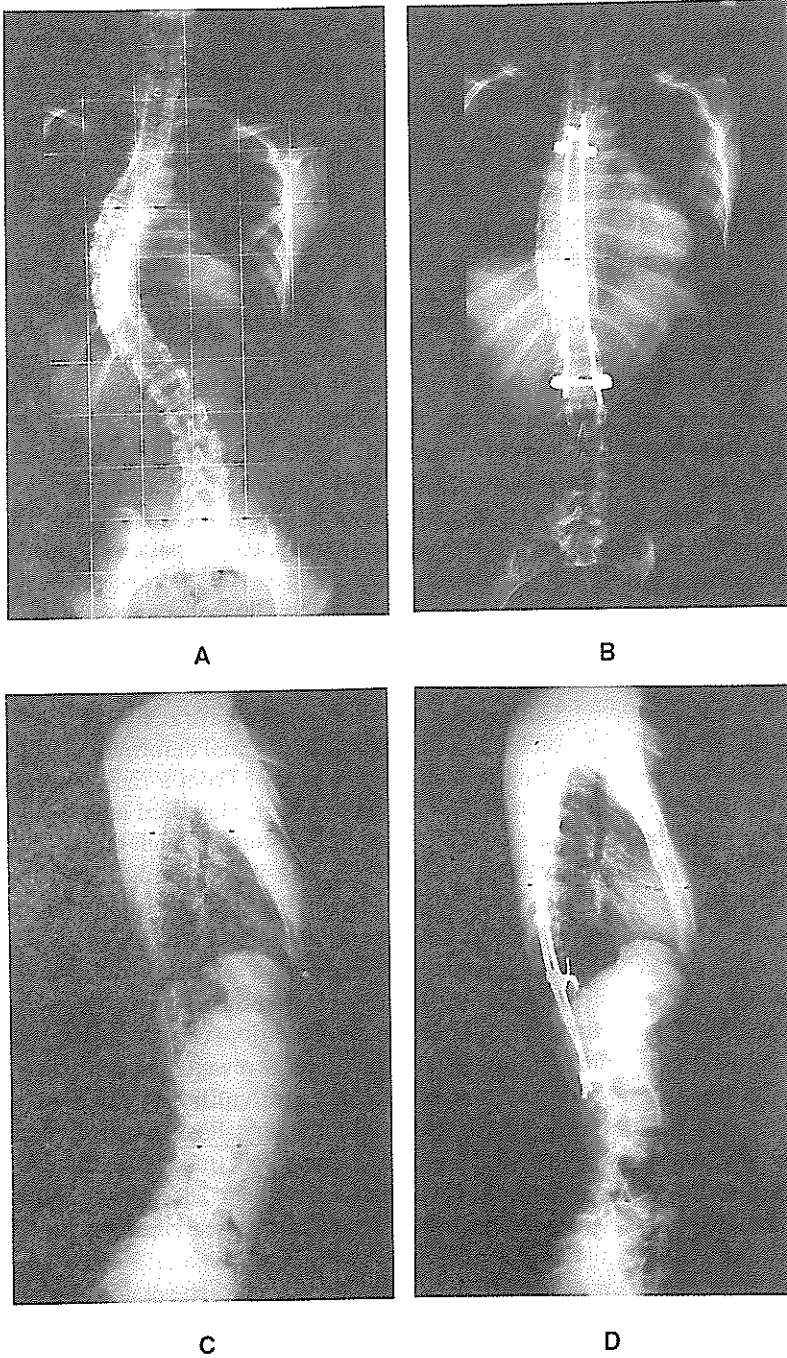


Fig. 1. 18-years old girl, affected with right thoracolumbar lordoscoliosis (King IV). **A:** Preoperatively, the curve measured 70°.

B: She underwent correction and fusion with Colorado, fusion was extended from T4 to L1. After surgery, the curve measured 20°.

C: Thoracic flattening of the kyphosis and lumbar hyperlordosis were corrected. **D:** Thoracic flattening of the kyphosis and lumbar hyperlordosis were corrected.

DISCUSSION

Having widely experienced surgical management of idiopathic scoliosis, first with Harrington and then with Harrington-Luque methods, we have welcome the opportunity of fitting more stable instrumentations, ensuring both 3-D correction and multi-segmental fixation, since the first generation of these new systems, represented by CD, was introduced. The Colorado technique is an evolution of the previous multi-segmental fixation systems and it is easier to apply. The peculiar features of this instrumentation have been studied to achieve a good correction, as well as a solid vertebral stabilization, requiring little space. Hooks (pedicular, laminar and transversal) and pedicle screws have a threaded pin, where a clip for the rod is easily fitted, before tightening the assembly by means of a nut. The rods are made of a special stainless steel (Orthinox); their diameter of 5 mm ensures an excellent elasticity and the lack of grooves gives a very strong resistance to the breakage (1, 4). Our preliminary experience with it, in the surgical treatment of idiopathic scoliosis, has given satisfactory results. This instrumentation can be implanted easily and requires little room; thanks to the opportunity of pre-bending the rods, which are characterized by excellent elasticity and strong resistance, the system can ensure important corrections on frontal plane by means of reduction by translation, while respecting or restoring physiological curves on sagittal plane: that is why, in our opinion, this device is particularly suitable for the surgical management of idiopathic scoliosis in adolescents (Fig. 1). Its particular

elasticity, as well as its stability, grant long lasting results when treating adults, as well.

When managing neuromuscular deformities, the main difficulty encountered by the surgeon is the correction of pelvic obliquity and subsequent fixation of the lumbosacral tract. To date the Luque system, implanted following Galveston technique, is the standard to refer to if we consider the results obtained using other instrumentation. Our study has proven that Chopin plates are likely to correct and stabilize the lumbosacral region, perhaps better than the Galveston system. This technique may well be the answer to the challenge of sacro-pelvic fixation in neuromuscular deformities, however a final conclusion requires wider series, as well as a longer follow-up.

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