Cotrel–Dubousset Instrumentation

Introduced in 1983, Cotrel–Dubousset Instrumentation is a treatment approach to scoliosis. Unlike Harrington rods, this treatment is more than just an osteodistraction mechanism and allows correction of some of the features of scoliosis untreatable by Harrington rods, such as rib hump.

Their improved rigidity obviated the need for a brace in most cases. Early results of this system in scoliosis surgery demonstrated a low pseudarthrosis and hardware complication rate.

The case material included 150 patients who underwent surgery between 1983 and 1986 in the Hôpital Saint Vincent de Paul, Paris. [1)].

CDI offered theoretical advantages over Harrington instrumentation and conservative (nonoperative) management [2)].

In 1991 Benzel et al., presented their experience with 28 patients who had incurred unstable thoracic or lumbar spine fractures and who were intraoperatively stabilized with the Texas Scottish Rite Hospital (TSRH) universal instrumentation system. These patients were treated over a 1-year period and reflect an evolving insight into the treatment of thoracic and lumbar spine trauma with universal instrumentation. The TSRH instrumentation system appears equivalent to the more established Cotrel-Dubousset system in most respects. The construct design of the TSRH system facilitates the safe application of a rigid spinal implant. No cases of instability or pseudoarthrosis were observed during an average follow-up period of 9 months, (minimum 3 months). As the surgical treatment plan evolved, shorter and more compact constructs were increasingly utilized. There were no cases of instrumentation failure, regardless of the number of spinal levels fused or the number of levels instrumented. The value of using short rods when possible is emphasized: they may decrease the incidence of delayed instability and discomfort related to loosening at the hook/bone interface compared to that observed when long-rod systems are used in association with short spine fusions causing a fusion/instrumentation mismatch [3)].

In 1988 the first 50 adult cases performed at Johns Hopkins were reviewed. Treatment of adult scoliosis with the CD system yielded results comparable to standard techniques. Curve correction was directly proportional to the preoperative flexibility with no loss of correction in any case. All patients went on to a solid arthrodesis, with only three patients requiring the use of postoperative orthoses. Operative time was initially prolonged during the phase of acquiring expertise with the system; however, blood loss and hospitalization were comparable. In both the scoliosis and kyphosis groups instrumentation and fusion incorporated the same number of levels as would have been required for conventional instrumentation systems. In the spondylolisthesis, tumor and trauma groups a total of 88 transpedicle screws was used in 18 patients without neurologic complications. Pedicle screws provided a fixation alternative in cases requiring laminectomies. In the 25 cases with tumors, spondylolisthesis, and trauma, CD instrumentation reduced the number of vertebral levels required for fixation. Compared to Harrington or Luque systems, the average number of motion segments spared per patient was 1.3 in the spondylolisthesis group, 2 in the tumor group and 2.1 in the trauma group. This study suggests that the CD system, although initially developed for idiopathic adolescent scoliosis, is versatile and can be safely and effectively applied to a variety of adult spinal conditions. In cases of spinal pathology due to neoplasm, spondylolisthesis, and trauma, CD instrumentation with the option of transpedicle fixation appeared to offer significant advantages over conventional methods, and an average of 1.6 lumbar motion segments could be preserved per case [4)].

CDI was used to stabilise thoracolumbar fractures at the Lucerne Spinal Center. The results of 23 patients were reviewed in 1989 with respect to completion of healing, change in neurological status, hardware complications, and follow-up radiographic parameters. Nine patients were braced and 14 were not braced post-operatively. Two elderly patients expired at 1 and 6 months following their injury from medical complications. Of the remaining 21 patients, all were evaluated at follow-up ranging from 6 to 28 months, mean 12.7 months. The evaluation revealed that all patients showed complete healing without significant neurological or hardware complications [5].

In 1990 Moreland et al., reviewed the results of 15 patients with unstable thoracolumbar fractures treated with CDI at an average of 24 months' follow-up. The results are promising and compare favorably with other forms of surgical and medical management. Postoperatively, there was a loss of 2 degrees in the angle of deformity and 0.9 mm of vertebral body displacement. Incomplete neurological injuries improved one or more Frankel grades in 75% of our patients. There were three complications (20%). CDI offers theoretical advantages over Harrington instrumentation and conservative (nonoperative) management [6].

The utilization of the Cotrel-Dubousset (CD) instrumentation for reduction of fracture dislocations of the spine requires special techniques unique to this rod/hook configuration. A rotational manipulation of the CD rod with special application of a “fulcrum” hook is essential to reduce and maintain reduction in fracture dislocations of the spine [7].

Mueller and Gluch retrospectively, documented for the first time a very high revisions rate in patients with adolescent idiopathic scoliosis (AIS) and treated by CD instrumentation. Nearly half of the instrumentation had to be removed due to late infection and late operate site pain (LOSP). The reasons for the high rate of late infections with or without fistulae and for LOSP were analysed and discussed in detail [8]

A total of 104 patients underwent transpedicular spinal instrumentation in the Department of Neurosurgery, University of Florida College of Medicine, Gainesville, using the Cotrel Dubousset instrumentation (71 cases) or the Texas Scottish Rite Hospital rod instrumentation (33). Surgery was performed for lumbar vertebral column instability secondary to fractures (28 cases), spondylolisthesis (29), tumors (four), vertebral osteomyelitis (two), or postoperative causes (41). Pseudoarthrosis due to failure of a prior fusion was present in 37 cases. The 55 men and 49 women (mean age 47 years, range 18 to 87 years) all presented with severe back pain. Signs or symptoms of neural compression were noted in 96 patients. Surgery consisted of neural decompression, internal fixation, and autogenous iliac bone grafting. Spondylolistheses were fused in situ, without reduction; otherwise, major spinal deformities were corrected. A total of 516 pedicle screws were placed. The mean extent of fusion was 2.7 motion segments (range one to six motion segments). A 96% fusion rate was obtained with a mean follow-up period of 20 months. There were no operative deaths. Major complications included one spinal epidural hematoma, three isolated nerve root deficits (two

transient, one permanent), and three wound infections (two deep, one superficial). Instrument failure eventually developed in 18 patients; nine were asymptomatic with a solid fusion and did not require further treatment and the other nine were symptomatic or had a pseudoarthrosis and required operative revision. Pedicle screw-rod fixation offers biomechanical advantages compared to other forms of internal fixation for the lumbar spine. It enables short-segment fixation with preservation of lumbar lordosis and adjacent normal motion segments. This technique provides a highly successful method to obtain arthrodesis, even with prior pseudoarthrosis [9)].

In 2016 a study examined long-term functional outcomes of patients treated with Cotrel-Dubousset (CD) instrumentation and determined whether distal level of instrumented fusion (L4 and L5) correlate with increased back pain or lower functional level.

Retrospective review of AIS surgeries from 1986 to 1996 was undertaken. Patient demographics and surgical data were collected via case-note audit. Patients were contacted and asked to complete a series of functional outcome questionnaires including visual analog scales (VAS) for pain, Short-Form 36 (SF-36), Scoliosis Research Society 22 (SRS-22) and Oswestry Disability Index (ODI) for function. ANOVA technique categorically compared outcome scores to most distal levels of fusion. Linear regression compared patient reported outcomes to time elapsed since surgery. Statistical significance was $p < 0.05$.

One hundred twelve patients were identified, 50 patients were contacted, and 22 agreed to participation and completed a full assessment. Follow-up time since surgery ranged from 15 to 26 years and age ranged from 30 to 43 years. Six patients reported daily VAS back pain of ≥5; with a mean of 2.5. Back pain was not associated with level of distal fusion ($p = 0.92$). ODI was 15.36, with six patients' ODI >20. No relationship was shown between ODI and distal level of fusion ($p = 0.72$). SF-36 and SRS 22 values were also not related to distal level of instrumentation. Patient reported VAS back pain scores ($r(2) = 0.18$, $p = 0.05$), ODI ($r(2) = 0.09$, $p = 0.17$), and SF-36 and SRS-22 were not worse in patients with longer follow-up over time. Back pain and certain functional score subcategories of the SF-36 and SRS-22 trended toward improved results over time.

Most patients who underwent multi-segment spinal fixation appeared to do well long-term, with minimal back pain. Lowest instrumented segment did not appear to be associated with increased back pain after 15 to 25 years follow-up [10)].

In 2017 Three hundred forty eight patients with idiopathic scoliosis were operated using Cotrel-Dubousset (CD) hybrid instrumentation with pedicle screw and hooks. Only patients with curvatures more than or equal to 61° were analyzed and divided in two groups: two stage surgery (N = 30) and one stage surgery (N = 46). The radiographic parameters as well as duration of operation, hospitalization time, and number of segments included in fusion and clinical outcome were analyzed.

No statistically significant difference was observed in correction between two-stage group (average correction 69%) and only posterior approach group (average correction 66%). However, there were statistically significant differences regarding hospitalization time, duration of the surgery, and the number of instrumented segments.

Two-stage surgery has only a limited advantage in terms of postoperative correction angle compared with the posterior approach. Posterior instrumentation and correction is satisfactory, especially taking into account that the patient is subjected to only one surgery [11)].

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