Manual Correction of an Acute Lumbar Lateral Shift: Maintenance of Correction and Rehabilitation: A Case Report with Video

Mark Laslett, FNZCP, PhD, Dip.MT, Dip.MDT

The presentation of a lateral shift or trunk list associated with development of acute low back pain is a common clinical event[1]. In the opinion of Porter and Miller, it is *undoubtedly associated with a disc protrusion* and associated with a poor prognosis for conservative management[2]. This acute onset deformity is variously called a sciatic scoliosis or lateral shift[3], trunk list[2], acute lumbar/sciatic scoliosis[4], *wind-swept* spine[5], or lateral deviation[6].

Prevalence of the acute lateral shift associated with back pain varies according to the clinical setting and circumstances. About a quarter of patients presenting on referral with low back pain to a physiotherapy clinic in New Zealand had a lateral shift[3]. Of 88 (12.5%) consecutive acute and chronic patients referred to physical therapy in the US, 11 were classified as having a relevant lateral shift[7]. Of 1776 patients presenting at a back pain clinic in England, 100 (5.6%) had a gravity-induced list[2]. In a Finnish chronic back population, 22 of 39 patients (56%) randomly recruited into a reliability study had a relevant lateral shift[8], and in a study of consecutive chronic back pain patients in the US, 36% had a relevant lateral shift[9].

The lateral shift can be either to the left or the right side[8,10-12] and may be towards the dominant side of pain (ipsilateral) or away from the side of the pain (contralateral). The majority of affected patients have a contralateral shift[3,11,13]. Occasionally, the shift may change from side to side, and this has been termed an *alternating scoliosis*[14]. The lateral shift may be explained either as avoidance of compression or irritation of a spinal nerve either actively or reflexively through muscle spasm[4,15-17], or as aberrant disk mechanics where a protrusion or herniation acts as a space-occupying phenomenon pushing the trunk away from the painful mass[2,3,10,18] in a contralateral shift presentation or collapse of the upper vertebral body into a large annular fissure producing an ipsilateral shift presentation[3,18]. Although the exact cause of the problem is usually unknown in any given patient, it is frequently and strongly associated with intervertebral disc pathology[2,3,10,13,19].

While it has been stated that the presence of a lateral shift carries a poor prognosis with conservative care[2], McKenzie has claimed that about 90% respond rapidly to manual correction[3], especially if the shift is contralateral. It has been reported that a lateral shift associated with a positive cross-leg straight leg raise test carries a poor prognosis with conservative care or following discectomy[20-22]. The McKenzie method of mechanical diagnosis and therapy (MDT) is one of the most common systems used in the management of spinal pain conditions[23,24]. In patients with a list, the method of manual correction has been shown to result in superior outcomes compared to a control treatment of nonspecific massage and general back care advice[1].

ABSTRACT: The acute onset lumbar lateral shift, otherwise known as a list or acute scoliosis, is a common clinical observation associated with low back pain. In general orthopaedics, the presence of a lateral shift is associated with a poor prognosis; however, a manual correction method devised by McKenzie is claimed to produce rapid reversal of the deformity and reduction in pain. This single-case report presents the details of the McKenzie Mechanical Diagnosis and Treatment (MDT) management of a major right-sided lateral shift, which includes the manual correction technique, self-correction and management, prophylaxis, pain ablation, and rehabilitation to a high level of athletic function, with long-term follow-up at 9 months. The lateral shift is widely accepted as being associated with disc pathology, but the exact mechanism of shift production remains speculative. Hypotheses include muscle spasm, avoidance of irritation of a spinal nerve, and space-occupying or space-deficient disc mechanics. The hypotheses used to explain the lateral shift phenomena are discussed. (Case report is supplemented by video stream, available at jmmtonline.com/).

KEYWORDS: Lateral Shift, McKenzie, Mechanical Diagnosis and Treatment (MDT), Scoliosis

Director of Clinical Services, PhysioSouth Ltd, Christchurch, Canterbury, New Zealand;
Senior Research Fellow, Auckland University of Technology, Auckland, New Zealand
Address all correspondence and requests for reprints to: Dr. Mark Laslett, mark.laslett@xtra.co.nz

This case study (with a supported video clip available at jmmtonline.com/) describes the examination and manual correction, using the method first described by McKenzie[3], in a patient with a large right-side contralateral shift. Progressive treatment is outlined including return to full high-level athletic function. The supplemental video allows visualization of the detailed instruction in maintenance and prophylaxis, and the interaction with the patient.

Patient Characteristics

History of Current Complaint

The patient was an athletic 41-year-old male of Chinese descent. He worked as a manager of a company and was a high-level martial arts participant actively engaged in teaching. He was referred by a family physician in November 2007 to a clinic of PhysioSouth Ltd, a private physiotherapy group in the South Island of New Zealand, and was seen the day of referral. He presented with acute left-sided low back pain three days after the onset of pain during a vigorous karate training session. The distribution of his pain is depicted on a self-administered shaded pain drawing (Figure 1). The darker color represents sharp stabbing pain and the lighter color represents aching or dull pain. Pain intensity was measured using 100mm horizontal visual analog scales (VAS) where on the left side of the scale, 0 equals *no pain* and on the right side of the scale, 100 equals *worst imaginable pain*. Three measures were recorded: current pain = 58/100, pain at its worst = 75/100, pain at its lowest level = 34/100.

The pain was confined to the left mid and lower lumbar spine without somatic or radicular pain referred into the buttock or lower extremity. The pain was aggravated by forward bending, sitting, walking, coughing, and sneezing; and it disturbed his sleep. Rising from chairs was especially painful and difficult. Standing still and lying down provided the best relief. The patient reported his bladder function was normal and did not indicate any symptoms suggestive of cauda equina compression. He was aware that his trunk was shifted to the right side in relation to his pelvis but had been unable to self-correct it. He had been taking ibuprofen, codeine, and diazepam for pain relief on prescription from his family physician. He reported that his health was good and he had no other medical conditions. He had not had any previous surgical intervention, and his body weight had remained stable in the preceding 12 months.

Prior to the current problem, the patient had experienced one episode of acute low back pain three months earlier that followed a fall onto the left buttock while snow skiing. The acute pain settled but never completely disappeared. He had returned to nearly full participation in karate training by the time the current acute episode started. Standard radiographs were acquired three weeks prior to the initial physiotherapy consultation as part of an ongoing investigation of the previous complaint. These radiographs are represented in Figures 2 and 3.

Examination

The patient had difficulty rising from the waiting room chair, and as he walked into the consulting room, it was imme-

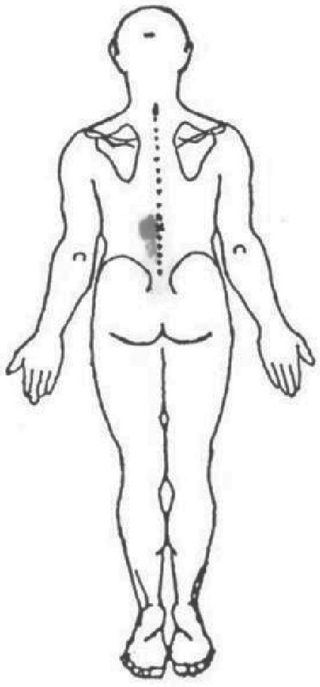

FIGURE 1. Self-administered pain drawing prepared at initial consultation.

Note: Lighter shade = "aching" or "dull" pain; darker shade = "sharp" pain

FIGURE 2. Erect AP radiograph acquired three weeks prior to initial physiotherapy consultation.

FIGURE 3. Erect lateral radiograph acquired three weeks prior to initial physiotherapy consultation.

FIGURE 4. Posterior view of right lateral shift deformity apparent at initial physiotherapy consultation.

diately apparent the trunk was shifted markedly to the right. The lateral shift deformity was confirmed on inspection (Figure 4) and the lumbar lordosis appeared to be reduced from what might be expected. Establishing the presence and sidedness of a lateral shift has been subjected to a number of reliability studies with some earlier projects reporting poor inter-examiner reliability[12,20] and later efforts such as those used in this case study showing good reliability[8,21]. He was able to walk on his toes and heels, and the patellar and Achilles tendon reflexes were present, symmetrical, and brisk. Range of motion was not measured goniometrically, but movements in all directions were severely restricted by pain, except right lateral flexion and right *side gliding in standing* (MDT assessment of lateral flexion of the lower lumbar spine), which appeared normal.

Clinical Impression

According to the MDT classification system, the acute onset of a contralateral lateral shift and painful obstruction to motions attempting to correct the shift and restore extension lead to a provisional diagnosis of mechanical derangement[3,10,25-27]. When the patient is in severe pain and the lateral shift deformity is visually obvious, confirmation of derangement by repeated movement testing proceeds concurrently with immediate intervention by initial correction of the lateral shift. There is a high probability (in the order of 90%)[3] that the presence of a directional preference to shift correction and asymmetric extension procedures will be confirmed within the first few treatment sessions[28], and that centralization of symptoms towards the spinal midline will occur. Based on this, a provisional diagnosis of lumbar discogenic pain was reasonable[9,29].

The absence of symptoms or signs of radiculopathy (numbness, weak key muscles or absent tendon reflexes) effectively rules out nerve root compression. Sacroiliac joint provocation tests were not carried out since pain arising from these joints is highly unlikely due to the high specificity of centralization to discogenic pain[29]. Furthermore, there are data indicating that sacroiliac joint pain is not confirmed in the presence of these findings[9,30,31]. The expectation of rapid pain centralization from previous experience also effectively ruled out the possibility of the lumbar zygapophysial joint as a source of pain for the same reasons[32].

Treatment

The patient was seen four times in the acute and subacute phase. The initial consultation three days after acute pain onset required 60 minutes for assessment and treatment. On the third day following the initial treatment, the patient was assessed as clinically stable. Thirteen days after the initial consultation, he was reviewed again and he assessed his recovery as 90% of full pain-less function at that time. He was aware of some movement at the base of the spine on rising in the morning. On examination it was observed that during standing flexion, there was a small lateral deviation first to the right and then to the left, rather than the expected normal smooth midline sagittal plane pathway, with minimal left lumbar pain felt at extreme end range of motion. Because the patient was keen to return to high-impact martial arts training and teaching, he was referred to a physiotherapy colleague within the PhysioSouth Ltd.

group for biomechanical assessment and retraining based upon the findings.

Interventions

Correction of the lateral shift deformity: In some cases, the patient can self-correct a lateral shift following verbal instruction. In the present case, the shift was very large, and manual correction was commenced immediately because self-correction attempts had failed. There are two essential components of achieving correction of the manual lateral shift that must be undertaken in strict sequence:

1. The patient stands with the feet about shoulder-width apart, not together, and the therapist adopts a position either sitting or standing where the manual procedure can be carried out comfortably. The therapist applies repeated and sustained side gliding mobilization by pulling the patient's hips and pelvis horizontally while directing counter-pressure to the trunk, again in a horizontal plane. The patient's near side elbow is flexed to 90° and provides a buttress against which the counter-pressure is applied at the level of the lower lateral ribs. It is important not to exert the counter-pressure at the level of the shoulder such that top-down lateral flexion movement is imparted. The impression the therapist and patient should have is that a lateral shearing motion is being imparted rather than anatomical lateral flexion. Initially, the applied pressure is gentle with rhythmic oscillations interrupted by pressure sustained for a few seconds. The therapist usually feels a solid resistance to the applied side gliding pressure at first, but over a period of time, which varies from case to case, the resistance appears to "soften" and a greater range of motion is achieved. This procedure is continued until all obstruction to the side gliding mobilization is cleared. Once full correction of the lateral shift is achieved, the second component of the procedure follows.
2. Restoration of lumbar lordosis. The patient is instructed to bend backwards while the manual shift correction is maintained. The patient's knees will flex to some degree for balance, but this should not prevent or substitute for achievement of lumbar extension in the overcorrected position. This is also repeated in a rhythmical fashion until as much extension is achieved as possible.

In the current case, correction of the lateral shift was achieved rapidly and the increase in pain experienced with the first corrective movements quickly diminished and ceased. As extension was restored in the overcorrected position, the initial increase in pain quickly subsided as well. During this process, it is essential to instruct the patient to breathe as normally as possible and not hold the breath or perform a Valsalva maneuver. Some patients report dizziness/faintness, and in this event, the patient is supported to a nearby treatment table and instructed to lie prone until the sensation passes. These symptoms are not evidence of harm, but perhaps of hyperventilation and are to be avoided if possible. This patient did not experience these symptoms.

Self-correction and maintenance of lateral shift correction: The patient was instructed in self-correction of the shift and retention of the gain in lumbar extension range of motion by active movements. The side gliding procedure may be carried out in the free standing position or against a wall, and in this case both methods were taught. This was followed by lumbar extension in the prone position, then standing. It was crucial to ensure that the patient understood the necessity of learning the self-correction procedure since stability of the correction is fragile in the first few days. This patient was instructed fully about avoidance of any lumbar flexion in any position, avoidance of twisting or lateral flexion movements towards the side of the lateral shift, and avoidance of asymmetrical standing with decreased weight-bearing of the leg on the side of pain. The strict flexion avoidance included sitting with a full lumbar lordosis. In the first few days, sitting was avoided as much as possible, but when necessary (driving to and from therapy, eating meals, etc.), an exaggerated lumbar lordosis was maintained at all times. Active abdominal bracing while standing and walking may also be taught to assist in improving stability. Despite the patient's best efforts, it was usual for the shift to return after the patient has left the clinic, and the patient was instructed to carry out the lateral shift correction and restoration of lumbar extension at least every hour, or more often if the pain worsens, radiates away from the spinal midline, or there is an awareness of the shift returning.

Recovery of flexion: Within a few days, careful re-introduction of lumbar flexion was attempted and progressed from an unloaded (supine) position to a loaded (sitting or standing) position. This period of flexion avoidance following reduction of the lateral shift often varies from a few days to a week or two, depending on a number of variables such as completeness of lateral shift reduction and recovery of lost lumbar extension; ability of the patient to retain flexion avoidance in the first two or three days; duration of symptoms where longer duration usually results in longer periods of flexion avoidance being required; severity of pain and the patient's ability to cope with it; other unknown variables, e.g., some patients take longer to stabilize than others despite appearing able to manage the first few days satisfactorily.

In this patient, recovery of flexion was possible on the third day. Initial testing in the supine position with the knees to chest or flexion in lying exercise revealed that after one set of ten repetitions, there was significant improvement in the range of standing flexion without an increase in pain or a recurrence of the lateral shift. The patient was instructed to continue the home exercise program of two hourly side gliding and extension exercises but to add ten supine flexion exercises. Before doing the flexion exercises, he was to check that no obstruction to self-correction of the lateral shift or lumbar extension had recurred. Immediately after the flexion exercises, he was to carry out lumbar ex-

FIGURE 5. Test for trunk extensors endurance (Biering-Sorensen).

FIGURE 6. Test for trunk flexors endurance.

FIGURE 7. Test for lateral trunk musculature endurance.

tension and side gliding exercises to ensure that no recurrence of obstruction to extension or of lateral shift had developed with the flexion exercises. In the event of recurrence, he was to cease the flexion exercises and return to the shift correction and extension protocol until review on the eighth day following the initial consultation.

Recovery of strength and agility: By nine days following the initial consultation, the patient had minimal pain, a good return of spinal mobility in all directions, and no evidence of the acute lateral shift deformity. However, he was keen to return to high-level martial arts training and was aware that this requires strength, agility, speed, and an ability to tolerate tumbles and falls without reinjury. On the fourth visit nine days after the initial consultation, he was tested for imbalances in core trunk endurance according to the method of McGill[33,34]. If indicated, a training program was to be initiated to address these imbalances as part of a progressive exercise program aimed at a return to high-level, high-impact athletic activity. Assessment of trunk strength and endurance using the McGill method is based on three simple tests[33,34]:

1. Extension endurance: The Biering-Sorensen test (Figure 5). The patient's trunk was held extended beyond a bench support that reaches to the pelvis while the legs were secured. The maximum time he was able to maintain this position was recorded (112 seconds).
2. Flexion endurance (Figure 6). The patient sat on the floor with hips

and knees partially flexed at an angle of about 55°, the lumbar spine in neutral and arms folded across the chest. The maximum time he was able to maintain this position was recorded (250 seconds).

3. Lateral flexion endurance (Figure 7). The patient assumed a full side-bridge position taking support on one elbow/forearm and both feet with the spine in a neutral position. The maximum time he was able to maintain this position was recorded for the right side (96 seconds), and after a short rest for the left side (80 seconds).

Calculations of flexion/extension and right/left lateral flexion endurance ratios were based on the test data. In this patient, the flexion extension ratio was 2.23 indicating an imbalance towards extension. According to McGill, values less than 1.0 are desirable with 0.84 being normal for healthy young men[33,34]. The right/left endurance ratio was 1.2 in favor of the right side. Differences of 0.05 between sides are considered abnormal. Right-side bridge/extension and left-side bridge/extension endurance ratios were calculated (0.86 and 0.71, respectively). According to McGill, ratios exceeding 0.75 are considered evidence of imbalance[33,34].

Outcome

The patient was seen by the gymnasium-based therapist on 10 occasions between early December 2007 and mid-February 2008 and instructed in exercises aimed at restoring full strength and power in all directions and addressing measured imbalances. This was achieved, and by mid-February 2008, he was seen by the author for review. The patient reported that the mild low back ache on rising in the morning had ceased and that he was fully engaged in martial arts training and teaching twice a week. In addition, he was attending the gymnasium 3 times a week to complete a series of challenging exercises, some of which are recorded on the online video. He still experienced some concern about minor feelings of *instability* in that he could feel the lower part of his back *move* at times. In the opinion of the author, he was possibly being hypervigilant regarding minor sensations. This was discussed and the patient was reassured that this did not represent some inherent instability. On examination, he had an excellent range of pain-free motion in all directions with smooth movement pathways without any apparent movement impairment.

On September 1, 2008, approximately 9 months after first presentation, the patient was reviewed by the gym-based therapist and re-tested using the three McGill tests for trunk endurance[33,34]. Flexion and extension endurance were 195 seconds and 170 seconds, respectively, and right and left lateral flexion endurance were 140 and 110 seconds, respectively. The flexion/extension ratio was 1.15; which indicated a reduction of the earlier recorded imbalance and an improvement of the extensors. The right/left endurance ratio was 1.3 in favor of the right side. Right-side bridge/extension and left-side bridge/extension endurance ratios were 0.82 and 0.65, respectively. Extension endurance had reduced and flexion increased. Imbalances had decreased but persisted.

Following trunk endurance testing, the patient was interviewed by the author and 12 minutes of the author's interview are available on the video. In brief, the patient had experienced two minor episodes of similar left-sided low back pain with associated right lateral shift. He was able to self-correct the shift and abolish the pain in three days using the skills and exercises taught during the initial treatment period. He was able to compete in an international martial arts competition in July and experienced no back pain at all. Good sitting posture and maintenance of trunk strength and endurance were reinforced. He was advised when it was appropriate to seek further treatment and was discharged from care.

Discussion

It must be emphasized that correction of the lateral shift and the ability to return to normal ranges of movement in this case were very rapid. The patient's complete lack of fear and his willingness to tolerate pain during shift correction was unusual. It is rare to encounter cases as easy to manage as this patient, and longer time frames from 2 to 5 days are the expected norm in this author's experience.

While the speed of recovery from acute pain in this case was unusual, the method and steps required are the same for all patients presenting with an acute contralateral lumbar shift. There are however, some caveats that must be emphasized in the interests of safety:

1. If the pain becomes progressively worse and/or peripheralizes (radiates further into the lower extremity) as shift correction and extension restoration proceed, the procedure should be abandoned.
2. If the patient reports the development or worsening of signs and symptoms of radiculopathy (weak key muscles, loss of tendon reflexes, numbness) or cauda equina compression (urinary retention, saddle anaesthesia, sexual dysfunction, loss of sphincter control), the procedure should be abandoned.
3. If correction of the lateral shift component does not proceed as expected in that the trunk cannot be pushed across the midline after one or two days of persistence in therapy and self-correction, it is likely that the condition is, at least temporarily, irreversible.
4. If the shift cannot be corrected, attempts to restore extension are highly likely to worsen or peripheralize the pain and the procedure should be abandoned.
5. If the patient continues to feel nausea or faintness during the attempt of shift correction without improvement, less vigorous methods of management should be attempted, at least initially.

A satisfactory explanation for the acute lateral shift remains elusive. In 1973, Finneson proposed that the topographical position of disc herniation in relation to the exiting spinal nerve accounts for the displacement[35]. In this theory, protrusions that are sited medial to the nerve root cause the trunk to shift towards the side of pain (ipsilateral), and

protrusions lateral to the nerve root cause the trunk to shift away from the side of pain (contralateral)[35]. The reason given is that the trunk position relieves pressure on or irritation of the spinal nerve[4,6,15-17,35-37]. To this author's knowledge, there are three reports with data able to evaluate this theory[2,13,19]. All three failed to demonstrate validity of the construct.

It is common to read radiology and other medical reports of a lumbar scoliosis where the deformity is regarded as evidence of muscle spasm. The hypothesis that the lateral shift and other acute deformities are caused by muscle spasm seems well entrenched[2,36-38], yet there is no evidence to support the notion. Muscle spasm causes significant pain locally in the muscles affected as any sufferer of cramp will confirm. If muscle spasm were a cause of the lateral shift deformity, then the pain would invariably be ipsilateral. This is clearly not the case in the vast majority of patients with acute lumbar deformities where the lateral shift away from the side of pain is the most common presentation, contrary to what this theory would require. Parenthetically, if acute deformity were to be caused by muscle spasm, the acute kyphotic spine would be accompanied by anterior pain (abdominal muscle spasm) or have a hip flexion deformity (psoas muscle spasm).

It is proposed that some form of mechanical disturbance of the intervertebral disc is associated with the deformity, if not its direct cause[2,4,10,17,19]. One may hypothesize that a contralateral shift is caused by a space-occupying disc herniation pushing the trunk away from the painful side whereas an ipsilateral shift results from collapse of the uppermost vertebra into a broad posterolateral annular fissure or defect causing the trunk to shift towards the painful side[18,25,27]. This hypothesis is purely speculative and needs further investigation. While it is reasonable to presume that an acute onset lateral shift is likely caused by the disc mechanics proposed above, serious medical conditions such as discitis[39] or osteoid osteoma[40] can present with this deformity.

Bizarrely, an acute kyphosis with or without a lateral shift is sometimes referred to as *camptocormia* and is considered to be an hysterical conversion state or an unusual corollary to central nervous system disease such as Parkinson's disease[41-43]. It is proposed that camptocormia is characterized by disappearance of the deformity when the patient lies down[44]. This phenomenon is frequently seen in patients with acute lateral shift[2]. It is reasonable to expect that patients with psychiatric disease will suffer acute mechanical disc lesions that may cause an acute deformity in similar proportions to non-psychiatric patients. However, the simple observation that an acute deformity disappears on recumbency, i.e. unloading, does not logically lead to a conclusion that a hysterical condition is the cause. Porter and Miller[2], and Weitz[4] have demonstrated that such deformities often disappear when unloaded.

The method of manual shift correction as described above has been developed by McKenzie[3,10,27], but other well-known authors also have advocated its use. Cyriax included it in the second volume of his two-volume text book series[45], and Maitland described the technique as well[46]. Apart from the MDT method of manual shift correction, the only other documented treatment specifically aimed at correction is a mirror image postural self-correction method, the Harrison Method, which has shown significant improvements in patients with chronic back pain with associated trunk list[47]. This method uses a sophisticated imagery technique of-self correction but does not appear to be superior to the McKenzie MDT method.

Further basic research is needed to elucidate the causal mechanisms involved in producing acute lumbar deformities and their treatment. One such study might compare the relative efficacy of the Harrison Method versus the McKenzie MDT method.

Conclusion

This paper reports on the use of the McKenzie MDT method of treatment of a lateral shift deformity associated with acute unilateral low back pain with supporting video to demonstrate the entire process. The deformity was abolished almost completely within an hour of the initial treatment, and the acute pain was relieved within 3 days. Rehabilitation to high-impact athletic function was achieved within 3 weeks and the patient achieved full return of all function by 2 months. Long-term follow-up at 9 months revealed sustained benefit in terms of pain, return of full function, and an ability to manage recurrences. The explanation for the deformity remains speculative, and research is needed to determine causes and optimal management strategies.

Online Video Parameters

The online video provides 13 minutes of the initial consultation. Subsequent treatments on the next 2 days (which required about 30 minutes) are condensed into 8 minutes of video coverage. A follow-up review occurred 8 days after the initial consultation and is presented by 8 minutes of video. By 9 days following initial consultation, the patient had minimal pain, a good return of spinal mobility, and no evidence of acute lateral shift deformity. The remaining elements of the video include endurance testing as well as exercises taught and practiced in the gym followed by 12 minutes of summative interview.

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