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Cervical Discography:

Clinical Implications From 12 Years of Experience

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Study Design. Positive pain responses provoked in an inclusive series of cervical discograms performed over a 12-year period were categorized by level and reviewed.

Objectives. To report the prevalence of cervical pathology over an entire series of patients, to determine whether a reproducible pattern of concordant pain could be associated with each symptomatic level identified, and to calculate the rate of complications.

Summary of Background Data. Cloward wrote the first articles explaining the technique of cervical discography and reported on the pain responses induced. Currently, the technique is viewed as an invaluable diagnostic tool, but it also is criticized for failing to contribute unique information beyond that available from imaging studies despite the inherent risks.

Methods. A series of 173 cervical discograms performed over 12 years was examined. Pain responses provoked and recorded during discography were grouped by disc level and examined for recurring patterns. The prevalence of disc pathology was calculated.

Results. In all, 807 discs were injected, and 404 concordant pain responses (50%) were elicited. Three or more abnormal disc levels were identified in more than half of the patients. Complications developed in four patients (2.3%). No further complications were reported. Surgical treatment was indicated as viable in only 35 studies.

Conclusions. Discography is a safe and valuable diagnostic procedure showing characteristic pain patterns that may have clinical significance. In more than half of the studies, three or more levels were identified as pain generators, suggesting that treatment decisions based on information from fewer discs injected during discography may be tenuous. [Key words: cervical discography, pain distribution, complications, cervical pathology] **Spine 2000;25:1382–1389**

For many practitioners, referred pain and symptomatic pain responses represent the most clinically useful information obtained from discography.[26,30,31,32] Many clinicians contend that discography is the best, and perhaps only, way to locate the specific lesions responsible for discogenic pain.[12,14,15,22,26,29] For others, the procedure adds little, if any, useful information beyond magnetic resonance imaging (MRI) and other imaging studies, and therefore is not thought to be worth the inherent risks.[8,21,28]

Schellas et al,[26] however, found that MRI of the cervical spine is not reliable in identifying either painful discs or anular lesions. Anecdotally, they relate that among their patients undergoing discography, many have undergone previous cervical surgery with unsatisfactory results. They attribute the surgical failures to the fact that operative decisions were based on imaging studies rather than on more accurate and informative discographic procedures.[11]

The purpose of this research was to review an entire 12-year series of patients who underwent discography, to report on the prevalence of abnormal cervical pathology over the entire series, to determine whether a reproducible pattern of characteristic (*i.e.*, concordant) pain could be associated with each symptomatic intervertebral level identified in the cervical spine during discography, and to calculate the rate of complications from discography.

Materials and Methods

Over the course of the 12-year period described in this study, approximately 2250 patients presented at the authors' spine specialty clinic with cervical pain, with or without accompanying arm pain. Of these 2250 patients, those who had intractable neck pain, and who failed extensive conservative treatment underwent discographic investigation to confirm the source of their chronic pain and to evaluate the viability of a surgical treatment plan. Between March 1984 and October 1987, 64 were performed using saline as the provoking agent. Subsequently, through November 1996, another 109 cervical discograms were performed using a contrast solution (Omnipaque 300) as the provoking medium. These were followed by computed tomography (CT) scans. The results from these 173 investigations were recorded prospectively, and all were reviewed for this study. No patient who underwent cervical discography for neck pain at the spine center during this period was excluded from this review.

The total number of records reviewed was 173, but because 13 patients underwent a second cervical discogram over the course of the 12-year period, the actual number of patients examined was 160 (7% of all 2250 cervical patients). The patients were 20 to 68 years of age (mean, 43 ± 8.7 years) at the time of discography. The male to female ratio was approximately 3 to 4. In 163 of the 173 instances wherein discography was ordered (it was the second discogram for 3 individuals), patients were able to provide information regarding the onset of their current pain episode. More than two thirds attributed their presenting symptoms to a specific incident: a motor vehicle accident, an on-the-job injury, a personal injury (*e.g.*, a fall or blow to the head), or a sudden movement. Only 49 individuals reported a gradual onset of their symptoms. The ratio of cervical pain as a primary *versus* secondary diagnosis was 2 to 1.

For 18 patients, surgery was imperative. These patients, in whom instability,[5] myelopathy,[9] postlaminectomy kyphosis,[2] herniated nucleus pulposus (HNP),[1] and Hangman's fracture[1]

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was diagnosed, underwent discography to determine which levels would be included in their fusion. The remaining patients all had failed to respond positively to exhaustive conservative therapies including traditional physical therapy, an exercise and conditioning program, back school, McKenzie mechanical assessment and treatment, and pain and stress management (*e.g.,* biofeedback, relaxation training, and cognitive-behavioral psychotherapy). Their pain continued and severely limited their work and leisure activities. Most of these patients experienced nonradicular pain. Careful history, physical examination, radiographs, MRIs and/or myelogram CTs, and psychological assessment could not adequately explain their pain. Surgical intervention was being considered as a last resort for these patients, so provocation discography was performed to determine its appropriateness as a treatment option.

Discography was performed in accordance with strict aseptic conditions by one of two highly experienced, board-certified orthopedic surgeons specializing in spine diseases. The procedure was performed in a custom-designed procedural suite using a high-resolution multidirectional C-arm fluoroscopic apparatus for guidance of needle placement into an intervertebral disc space. Patients were awake for the procedure and under mild intravenous sedation, usually 5 to 10 mg of Valium. No intravenous antibiotics were administered to the first 151 patients, whereas the last 22 patients received intravenous cefazolin before commencement of the procedure. The patients were placed in the supine position, with the neck slightly extended. The neck was prepared with hibiclens scrub and betadine solution, and then draped. The discographer was masked and sterilely gloved and gowned.

Cervical discography was performed using a right-side approach. The anterior vertebral bodies were identified by palpation. The trachea and esophagus were displaced medially across the anterior aspect of the spine, and the carotids were displaced laterally, allowing palpation of the vertebral endplate prominences. A single, styletted 22-gauge needle was introduced into each disc space to be studied, and needle placement was verified with fluoroscopy. All needles were placed before the first injection. Discs were injected randomly so that patients were unaware of which disc was being injected at any given time. This method was used to allow for random repeated injections, and to permit pain patterns to be defined as objectively as possible.

Discs were stressed by injecting a saline solution (before November 1987) or a contrast medium (beginning November 1987) into each segment. An injection was terminated if pain was produced, if a firm end point was reached, or if the disc was loose and accepting a larger amount of medium than expected. The following data were recorded during the procedure as each disc was being studied and before the stimulation of another disc: the amount of contrast instilled (in cubic centimeters), the resistance to injection (on a 4-point scale from "very firm end point" to "very loose end point"), the patient's pain response (on a 6-point scale from "no pain" to "worse than typical home pain"), and the appearance of the disc on fluoroscopy (on a 5-point scale from "normal" to "grossly degenerated"). All needles were left in place until all accessible discs had been examined. Anteroposterior and lateral radiographs were taken to document correct needle placement and disc appearance (Figure 1). After discography, CT scans also were taken for examination of the disc morphology in greater detail.

A disc was determined to be symptomatic if on injection the patient experienced pain exactly like their typical home pain

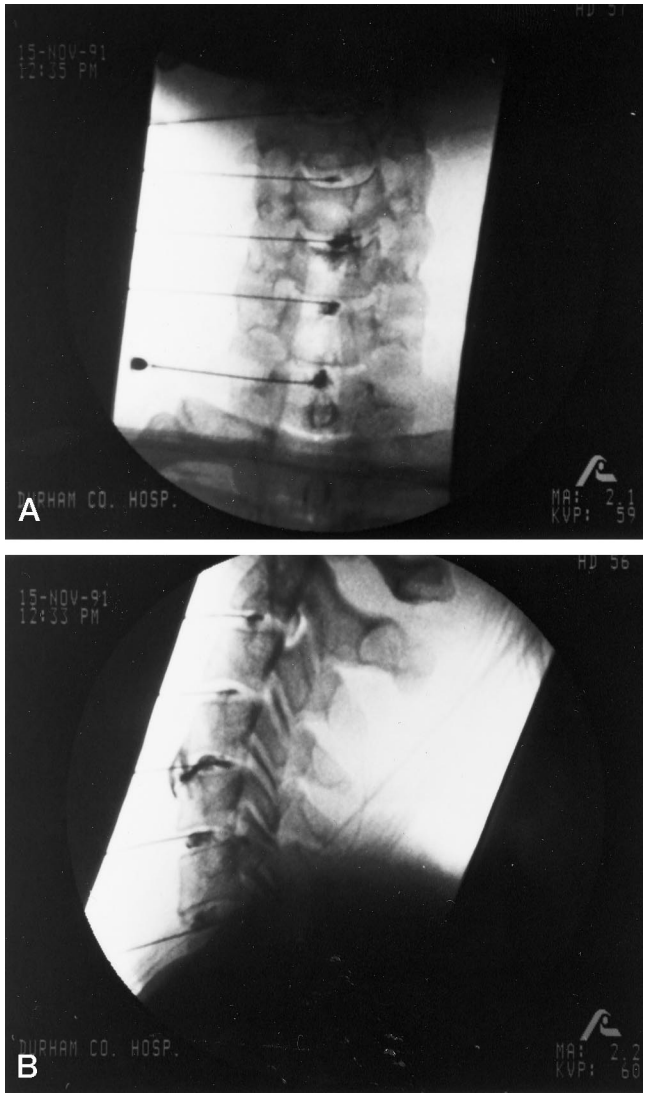

Figure 1. Anteroposterior (**A**) and lateral (**B**) radiographs taken during cervical discography of a 32-year-old man. Radiographs show needle placement at C2–C3 through C6–C7. All levels are normal in appearance and nonpainful except for C4–C5, which produced concordant (like home) pain and appears degenerative.

(*i.e.,* concordant pain). A healthy disc that produced no pain beyond the discomfort of the injection itself was labeled asymptomatic. In some instances, nonconcordant pain was provoked by injection, and these discs were considered indeterminate. For most patients, all disc spaces between C2–C3 and C6–C7 were injected. Discs were not examined if osteophytes inhibited needle entry, if the disc space was fused, or if four consecutive discs were found to be degenerative and painful and the additional level appeared clinically difficult to enter.

■ Results

Of the 173 discograms performed, 24 (18 from the saline group and 6 from the contrast group) were negative (*i.e.,* no pain responses were provoked). Of the discs injected with contrast, one study was radiographically normal in appearance; one showed evidence of early degenerative changes and provoked nonconcordant (unfamiliar) pain at four levels; three studies showed early degenerative

Table 1. Number of Discs Injected and Concordant and Nonconcordant Pain Responses at Each Cervical Disc Level

Level	Number of Discs Injected	Concordant Pain Responses	Concordant Responses (%)	Nonconcordant Responses	Nonconcordant Responses (%)
C2–C3	156	48	30	14	9
C3–C4	168	94	55	17	10
C4–C5	164	98	58	11	7
C5–C6	152	91	55	14	8
C6–C7	146	69	45	13	8
C7–T1	21	4	17	0	0

changes at two or three levels but produced no pain; and one study showed degenerative changes at three levels and produced initial pain on injection but no further pain similar to home pain. In all, 807 cervical disc spaces were injected, eliciting 404 concordant pain responses (50%) and 69 nonconcordant pain responses (9%).

Complications were rare. Three cases of discitis were recorded, affecting 1.7% of the patients treated and 0.37% of the discs injected. None of these patients had a history of diabetes mellitus or immune deficiency. All three cases were treated nonoperatively. One case of retropharyngeal abscess also was reported. Blood cultures from this patient showed growth of Group C beta homolytic streptococcus. This abscess eventually required operative drainage. Intraoperative cultures were consistent with oropharyngeal flora contamination (*i.e., Bacteroides oris, Bacteroides intermedius,* and *Clostridia* species).

Intravenous antibiotics were not administered routinely when the first 151 discographies were performed. After the occurrence of the aforementioned complications, however, intravenous cefazolin was prophylactically administered to all patients before commencement of the procedure. All patients were followed up, with the exception of one who was seen for a second opinion only and returned to his referring physician for further treatment.

Multiple-Level Disc Disease

Table 1 presents the number of concordant and nonconcordant pain responses elicited at each disc level injected. The proportion of symptomatic discs at C3–-C4, C4–C5, and C5–C6 are similar. More than half of all the discs injected at these levels produced concordant pain with injection. Of greater importance, however, was the number of patients experiencing concordant pain at multiple disc levels. Table 2 depicts this information, and also illustrates which discs were positive in isolation or in combination with other levels. Of the entire sample, 65% had pain produced at two or more levels. Approximately half (47%) had symptomatic discs at three or more levels. If the number of patients with negative discograms is eliminated (*i.e.,* the proportion of patients with multiple-level symptomatic discs is calculated using only the patients with at least one concordant pain response), then these numbers dramatically increase. It can be seen that 75% of the patients with at least one symptomatic disc had in fact two or more symptomatic levels, and that 54% had three or more painful disc levels.

Judging from the prevalence of multilevel degenerative disc disease identified through discography, surgical management was considered appropriate in only 20% of the 173 studies examined. Of the 35 individuals offered surgery, 30 accepted. Table 3 presents the information gained by discography that assisted in the surgical decision-making process for these patients. The remaining five patients had each been diagnosed with degenerative disc disease. Additionally, one patient had early myelopathic changes. These five patients did not undergo surgery for the following reasons: one patient was arrested and in jail; one patient accepted early retirement, and the subsequent change in lifestyle made this patient's pain level more tolerable; one patient was identified through psychological assessment as "a loner" with "no apparent support structure," and this patient opted for further conservative treatment; and the remaining two patients wanted more time to consider surgery and over time were lost to follow-up assessment.

Characteristic Pain Patterns

The primary pain experienced at the injection of each disc was described by the patient during the discogram. The location of the pain produced as each segment was stimulated during discography was coincidental to the pain patterns described by Schellhas et al[26] in their study of cervical discogenic pain, and by Dwyer et al[9] in their investigation of pain produced by stimulating the zygopophyseal joints in the cervical spine. The location of characteristic pain at each cervical intervertebral disc space is summarized in Table 4 and graphically represented in Figure 2. Not surprisingly, the higher the symptomatic level, the higher was the location of the associated pain. For these patients, no head pain was described when discs below C3–C4 were injected. Discs at C5–C6 and below were implicated when arm pain was experienced, except in one patient who reported arm pain during the stimulation of C4–C5.

Examination of the data showed that these pain patterns were infrequently bilateral. Patients were quite clear in identifying their familiar pain as unilateral. On rare occasions, discography provoked pain on the opposite side of a patient's typical pain. In these instances, the pain was recorded as nonconcordant. At most cervical

Table 2. Location and Frequency of Positive Cervical Discs

Pattern	C2–3	C3–4	C4–5	C5–6	C6–7	C7–T1	Number of Cases
One level positive	+	−	−	−	−	−	3
	−	+	−	−	−	−	7
	−	−	+	−	−	−	7
	−	−	−	+	−	−	13
	−	−	−	−	+	−	6
	−	−	−	−	−	+	1
							Total 37
Two levels positive	+	+	−	−	−	−	2
	+	−	+	−	−	−	1
	−	+	+	−	−	−	6
	−	+	−	+	−	−	5
	−	+	−	−	+	−	5
	−	−	+	+	−	−	4
	−	−	+	−	+	−	4
	−	−	−	+	+	−	4
							Total 31
Three levels positive	+	+	+	−	−	−	6
	+	+	−	+	−	−	1
	+	+	−	−	+	−	1
	+	−	+	+	−	−	1
	+	−	+	−	+	−	1
	−	+	+	+	−	−	12
	−	+	+	−	+	−	4
	−	+	+	−	−	+	1
	−	+	−	+	+	−	2
	−	−	+	+	+	−	9
							Total 38
Four levels positive	+	+	+	+	−	−	9
	+	+	+	−	+	−	3
	+	+	−	+	+	−	1
	+	−	+	+	+	−	1
	−	+	+	+	+	−	10
	−	+	+	+	−	+	1
							Total 25
Five levels positive	+	+	+	+	+	−	Total 17
Six levels positive	+	+	+	+	+	+	Total 1
Totals	156	168	164	152	146	21	

disc levels, some patients experienced pain along the midline, describing it, for example, as in the middle or center of their head or neck, or between their shoulder blades. These responses were regarded as indicating bilateral rather than unilateral pain. Table 5 portrays the proportion of unilateral and bilateral pain patterns recorded among these patients.

An inspection of this data (see Table 6) shows that anterior chest pain, when present, is associated with a positive pain response only at C6–C7. Of the 66 patients who had a concordant pain response at this level, four specifically mentioned chest pain during discography. A review of the pain diagrams drawn by these four patients before diagnostic testing showed that none had included

Table 3. Information Needed From Discography Before Planning Surgical Intervention

No. of Patients (n = 35)	Diagnosis	Reason for Discography
9	Myelopathy	To identify symptomatic levels that could be included in fusion to correct myelopathy and further reduce axial and referred pain
2	Postlaminectomy kyphosis	To identify symptomatic levels that might be included in fusion to correct kyphosis
5	Instability 1 at C1–C2 2 Traumatic 2 Degenerative	To determine which levels might be added to fusion to correct instability and further reduce axial and referred pain
17	DDD	To identify all symptomatic levels that might be included in a fusion to relieve pain
1	HNP	To identify any symptomatic level(s) contributing to axial or referred pain that can be corrected in addition to the HNP
1	Hangman's fracture	To identify abnormal levels that might be included in fusion to correct hangman's fracture

DDD = degenerative disc disease, HNP = herniated nucleus pulposus.

Table 4. Patients' Reported Pain Perceptions During Provocation Discography

Cervical Disc Level	Location of Pain Produced
C2–C3	Upper cervical area, often extending into occipital region and head; possibly accompanied by headaches in occiput and/or frontal region; pain has been experienced anteriorally in throat and into ears.
C3–C4	Similar to C2–C3 pain, but extending less into occiput; overlays levator scapulae muscle; fewer patients experience headaches; interscapular pain mentioned for first time; anterior throat pain.
C4–C5	Posterior and posterolateral neck pain extending into top of shoulder and possibly into scapula; more distal than C3–C4 pain response; no head pain described.
C5–C6	Pain experienced primarily in the shoulder girdle, often extending upward to midcervical area; adjacent to or coincidental with spine; first involvement of upper limb pain.
C6–C7	From base of neck extending into lower shoulder and shoulder blades; involvement of anterior neck; arm pain; only level where chest pain has been reproduced during discography.
C7–T1	Between shoulder blades and sometimes lower than C6–C7 injection; "back" of shoulders; down arm into elbow.

chest pain in their pain drawing. Conversely, 20 patients, although not experiencing chest pain during discography, had indicated chest discomfort on their pain drawing as part of their typical pain experience (cardiac involvement was ruled out by a specialist). Half of these patients[10] did have a concordant pain response at C6–C7 during discography.

■ Discussion

One of the most noteworthy observations gained from this series of cervical discographic studies concerns the prevalence of multilevel degenerative disc disease. More than half of the patients with at least one symptomatic disc were, in fact, diagnosed with significant degenerative changes at three or more levels of the cervical spine. The implication is that by limiting the number of disc spaces investigated through discography, the actual number of abnormal discs may be underestimated. This, in turn, has an impact on postoperative results if surgical intervention is planned. Schellhas et al[26] argued that in their clinical experience, when more than two levels produce concordant pain on discographic injection, it is preferable to defer operative intervention.

The strategy for selecting the discs to be investigated during discography varies among practitioners. Because a high percentage of patients in this study exhibited multilevel involvement in the reproduction of their pain, a reasonable approach is to inject all accessible cervical disc spaces. Other clinicians have corroborated this standard.[15,26] Aprill and Bogduk,[1] in their retrospective study on the prevalence of zygopophyseal joint pain, stated that when they performed discography, they investigated one to four discs per patient, selecting the levels based on the purported pain distribution and/or suspicious findings from imaging studies. Whitecloud and Seago[32] suggested performing discography on three levels, usually C4–C5, C5–-C6, and C6–C7. If it had been assumed that C4–C5 was asymptomatic and therefore functioning as a control level, this strategy would have missed inspecting the C3–C4 intervertebral level, which in the current series was found to be almost as frequently abnormal as C6–C7. Again, on the basis of the high percentage of patients with multilevel disc disease in this study, the authors believe that discography is inadequate if not performed on all accessible cervical discs.

The proportion of cervical discs identified as symptomatic likewise varies among studies. In the current series, 50% of the discs capable of injection produced concordant pain. Parfenchuck and Janssen[24] obtained the slightly higher incidence of 57%. Other studies found similar rates.[1,2] Connor and Darden[8] examined 31 patients with discography, reporting that 26 of these (84%) experienced concordant pain. Although they identified the C5–C6 and C6–C7 disc spaces as those most commonly symptomatic, Connor and Darden did not include information on how many levels were injected per patient. Shinomiya et al[28] compared the proportion of positive pain responses elicited from symptomatic patients with those of asymptomatic volunteers and found that 65% of the discs injected in the symptomatic group reproduced familiar pain *versus* 50% of the asymptomatic group. No information was given regarding nonconcordant pain responses in the symptomatic group. For a thorough understanding of discographic results, information on concordant and nonconcordant pain responses is essential.

Schellhas et al[26] also looked at discographic outcomes in an asymptomatic group. They found that in 17 of 20 discs found to be normal on MRI, discography identified painless, anular tears. This result supports the observation that injection of a nonionic contrast material will not of itself produce pain in asymptomatic patients, even in the presence of anular tears. Furthermore, the use of contrast is essential to visualize both painful and nonpainful lesions of the anulus.

This investigation aimed to examine a complete series of cervical discographic studies, and to determine whether reproducible patterns of characteristic pain could be associated with each symptomatic cervical vertebral level identified during discography. As Cloward first described,[7] there is a consistent and predictable area of pain provoked at each cervical spine segment during discography. Similar pain distributions have been reported by other authors, most recently by Dwyer et al,[9] although they were investigating pain patterns produced by the stimulation of zygapophysial joints. For the patients in the current study, the pain distributions were not pathognomonic. There was a great deal of overlap between the pain produced at each of the cervical spine segments. Clinically, however, patients with a positive

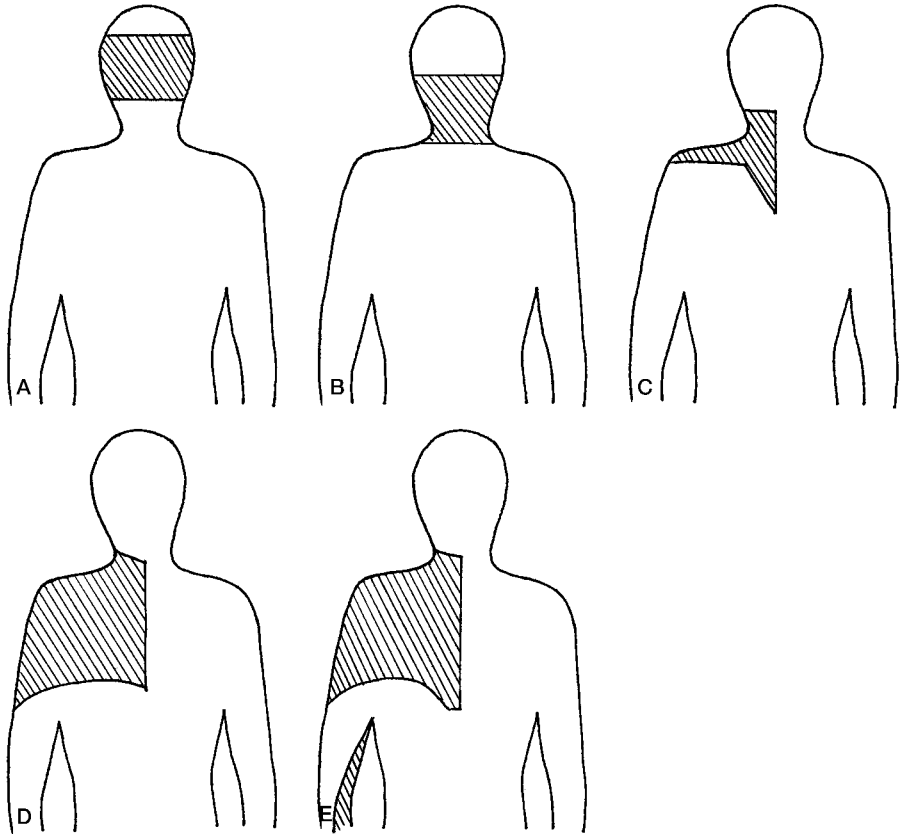

Figure 2. Pattern of pain provoked by discography at each cervical level: C2–C3 (**A**), C3–C4 (**B**), C4–C5 (**C**), C5–C6 (**D**), and C6–C7 (**E**). For purposes of illustration only, pain is depicted as unilateral to the left at C4–C5 through C6–C7.

response at C2–C3 and C3–C4 were more similar than dissimilar. Likewise, symptomatic discs at C4–C5 and C5–C6 produced similar pain distributions. The C6–C7 and C7–T1 painful discs produced a third profile roughly separable from the second and clearly distinguishable from the first.

Although Schwarzer et al[27] demonstrated that in patients presenting with chronic low back pain the combination of discogenic pain and zygapophysial joint pain is uncommon, the relation between the two sources of pain in the cervical spine is as yet unclear. Several recent studies concluded that zygapophysial joint pain in the cervical spine is not rare, that it may occur in conjunction with pain produced during discography as frequently as 62% of the time, and that it may be a potent additional source of headache as well as neck or shoulder pain.[1,2,4,6,9,17] Bogduk and Aprill[3] suggested that conclusions based on discography alone could be false because half of the patients will have concordant pain produced by stimulation of both the disc and the facet joints, or because an asymptomatic disc will be associated with a painful ipsisegmental zygapophysial joint.

Table 5. Proportion of Bilateral and Unilateral Pain by Intervertebral Level

Level Injected (n)	Unilateral Pain (%)	Bilateral Pain (%)
C2–C3 (156)	54	46
C3–C4 (168)	66	34
C4–C5 (134)	61	39
C5–C6 (152)	54	46
C6–C7 (146)	52	48
C7–T1 (21)	50	50

Nevertheless, the purpose of discography is to confirm the identity of painful, abnormal intervertebral disc spaces when surgery is being considered as a treatment option for nonradicular discogenic pain. Discography confirms the diagnosis of discogenic pain. In the experience of the current authors, most patients have pain resulting from multiple disc spaces, and for these patients, surgical options are severely limited. In patients for whom surgical intervention is being considered, however, it is imperative to confirm the morphologic integrity of the disc spaces that will be transitional after surgery. Cervical discography, using a contrast medium as the provocation agent, shows that morphologic abnormalities exist in many cervical disc spaces, even among asymptomatic volunteers.[26] The current authors believe that this information is essential for avoiding surgical failure.

Data from this series corroborate observations found elsewhere, namely that degenerative discs at C6–C7 may produce anterior chest pains in addition to pain in the more expected lower neck and shoulder girdle region.[26] The discrepancy between patient inclusion of chest pain on a pain diagram and mention of chest pain in either clinic notes or during discography is curious and perhaps evidence of a bias in the pain reports that clinicians ex-

Table 6. Incidence of Chest Pain Noted by Patient

	Concordant Pain Response During Discography		Chest Pain Reproduced as Part of Concordant Pain		Chest Pain Included in Patient Pain Drawing	
Patient	Yes	No	Yes	No	Yes	No
1	Y		Y			N
2	Y		Y			N
3	Y		Y			N
4	Y		Y			N
5	Y			N	Y	
6	Y			N	Y	
7	Y			N	Y	
8	Y			N	Y	
9	Y			N	Y	
10	Y			N	Y	
11	Y			N	Y	
12	Y			N	Y	
13	Y			N	Y	
14	Y			N	Y	
15		N		N	Y	
16		N		N	Y	
17		N		N	Y	
18		N		N	Y	
19		N		N	Y	
20		N		N	Y	
21		N		N	Y	
22		N		N	Y	
23		N		N	Y	
24		N		N	Y	

pect in certain patients. Clinicians may neglect to ask specifically about chest pain during the history and physical as well as during the discographic study. Therefore, the incidence of chest pain may be underreported.

Finally, the prevalence of complications and their severity have been used to dissuade surgeons from using discography. Reports of discitis after discography performed under sterile conditions by an experienced discographer are rare.[5,13,19,20,23,30] However, other researchers have argued that it is underreported and therefore much more common, occurring in as many as 1 of every 30 patients.[8,10] Other complications reported include epidural abscess secondary to discitis,[18,25] a herniated cervical disc,[31] and sudden onset of quadriplegia.[16]

In this study, the complication rate after cervical discography was very low, with discitis affecting only 0.37% of all discs injected. Nevertheless, beginning with patient number 152 in this series, and in all subsequent cervical discographic studies, every patient was (and is) injected prophylactically with intravenous cefazolin. It is difficult to determine whether the technique of leaving all needles in place until the last injection is performed (*vs* using a single needle to study each disc individually, as done by Schellhas et al,[26] or using a double-needle technique, as recommended by Guyer et al[13]) contributed to the infection rate. Regardless, the current authors believe that their method of random, repeated injections is appropriate and necessary for objectifying and defining pain patterns.

In summary, the current authors believe that surgery rarely is necessary in the treatment of mechanical neck pain. If, however, surgery is being considered because of severe and disabling symptoms, even after exhaustive assessment and nonoperative treatment, then discography is not only useful, but necessary to determine surgical levels. In this series, only 10% of the patients (17 of 173) evaluated with cervical discography for disabling mechanical neck pain, with or without referred shoulder and arm pain, were surgical candidates. For 18 other patients (another 10%), operative intervention was considered necessary because of instability or neural compressive syndromes. For these patients, discography was helpful in selecting possible adjacent levels to fuse in an effort to decrease associated mechanical neck and referred arm pain.

■ Conclusion

This investigation supports the use of discographic investigations for identifying the source of chronic neck and shoulder pain, with or without accompanying arm pain and headache. The prevalence of multilevel degenerative, symptomatic discs in the cervical spine requires a complete investigation of all accessible disc spaces before the formulation of treatment options, but especially before surgical intervention is offered.

■ Key Points

- Disc pathology produces predictable pain distributions.
- Discography should be performed at all assessable levels.
- Multilevel degenerative disc disease is frequent in the cervical spine.
- There is a low rate of occurrence of complications related to cervical discography.

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Point of View

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Conviction is not a substitute for truth. Surgeons may be convinced that they know about neck pain. They may be convinced that it most commonly arises from the C5–C6 disc. They might even test their beliefs by ordering discography at C5–C6, and perhaps at either or both of the adjacent levels. When this test proves positive, it appears to confirm their diagnosis, and repeated confirmations of this sort reinforce their conviction. But they can be wrong.

When surgeons sample only at their preferred level, they introduce a sampling bias. They may well prove to themselves that the C5–C6 disc does hurt as suspected, but when they sample only that disc or its immediate neighbors, they do not show that other discs are not also painful. It could be that discogenic neck pain is not unifocal. In which case, testing only the conventional or preferred level creates illusions of successful diagnosis. This is what Grubb and Kelly demonstrated in their articles in this issue. By testing all available levels in their patients, they found that single-level discogenic pain is not the rule; nor is two-level disease. Nearly half of their patients were symptomatic at three or more levels. This result calls into question the tradition of evaluating only the lowest or the suspected levels. Traditional convictions are mistaken. Cervical discography is not complete or valid unless and until all levels are tested.

Diehards might protest that in their hands discography at one or two levels is nevertheless valid. However, that is wishful thinking (*i.e.,* wishing that Grubb and Kelly are wrong because their results refute traditional convictions). The correct response is for others to repeat the study of Grubb and Kelly, providing contradictory data as opposed to self-serving conjecture.

However, the news is not all bad, particularly for discographers. The results of Grubb and Kelly now invert the controversy. Only 10% of their patients underwent surgery. Cervical discography is not a procedure that fosters surgery. Rather, when performed assiduously, it is a means of protecting patients from unwarranted surgery.