



**Staff Meeting Bulletin
Hospitals of the » » »
University of Minnesota**

**Herniated
Intervertebral Disc**

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William A. O'Brien, M.D.

I.

UNIVERSITY OF MINNESOTA MEDICAL SCHOOL

CALENDAR OF EVENTS

Mar. 2 - Mar. 8, 1946

Medical Visitors Welcome

No. 103Saturday, Mar. 2

- 9:00 - 9:50 Pediatrics Grand Rounds; I. McQuarrie and Staff; W-205 U. H.
- 9:15 - 10:20 Surgery-Roentgenology Conference; O. H. Wangensteen, L. G. Rigler, and Staff; Todd Amphitheater, U. H.
- 9:00 - 9:50 Medicine Case Presentation; C. J. Watson and Staff; M-515 U. H.
- 10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.
- 11:30 - 12:20 Anatomy Seminar; Cortico-Adrenal, Ovarian, and Testicular Tumors of Mice; Dr. Arthur Kirschbaum; I.A. 226.

Sunday, Mar. 3

- 11:00 - 1:50 Obstetrics and Gynecology Grand Rounds; J. L. McKelvey and Staff; Station 44, U. H.

Monday, Mar. 4

- 9:00 - 9:50 Roentgenology-Medicine Conference; L. G. Rigler, C. J. Watson and Staff; Todd Amphitheater, U. H.
- 9:00 - 10:50 Obstetrics and Gynecology Conference; J. L. McKelvey and Staff; Interns Quarters, U. H.
- 12:15 - 1:15 Pediatrics Seminar; Irvine McQuarrie and Staff; 6th Floor Eustis.
- 12:15 - 1:15 Obstetrics and Gynecology Journal Club; M-435, U. H.
- 12:30 - 1:20 Pathology Seminar; The Use of Radioactive Phosphorous in the Treatment of Polycythemia; Dr. Howard L. Horns; 104 I. A.
- 12:30 - 1:20 Physiology Seminar; Quantitative Analysis of the Electrocardiogram; Dr. Ernst Simonson; 214 M. H.
- 4:00 - School of Public Health Seminar; A Medical Entomologist in the Army; Mr. Theodore A. Olson; 6th Floor Student Health Service Bldg., Women's Lounge.

Tuesday, Mar. 5

- 9:00 - 9:50 Roentgenology-Pediatrics Conference; Solveig Bergh, Thomas Merner, Stanley Peterson; Eustis Amphitheater, U. H.
- 12:30 - 1:20 Pathology Conference; Autopsies; Pathology Staff; 102 I. A.

- 3:15 - 4:15 Gynecology Chart Conference; J. L. McKelvey and Staff; Station 54, UH.
 4:00 - 4:50 Surgery-Physiology Conference; Physiological Aspects of Frostbite; Dr. Dennis and Dr. Hemingway; Eustis Amphitheater.

Wednesday, Mar. 6

- 8:00 - 8:50 Surgery Journal Club; O. H. Wangensteen and Staff; M-515 U. H.
 9:00 - 10:30 Pediatrics Staff Rounds; W-205 U. H.
 9:00 - 10:50 Neuropsychiatry Seminar; Staff; Station 60 Lounge, U. H.
 11:00 - 11:50 Pathology-Medicine-Surgery Conference; Aortic Aneurysm; E. T. Bell, C. J. Watson, O. H. Wangensteen and Staff; Todd Amphitheater, U. H.
 12:30 - 1:20 Physiology Chemistry Journal Club; Staff; 116 M. H.
 4:00 - 6:00 Medicine and Pediatrics Infectious Disease Rounds; W-205 U. H.

Thursday, Mar. 7

- 9:00 - 9:50 Medicine Case Presentation; C. J. Watson and Staff; Todd Amphitheater, U. H.
 12:30 - 1:20 Physiological Chemistry; Cyrus P. Barnum; 116 M. H.
 4:30 - 5:20 Ophthalmology Ward Rounds; Erling Hansen and Staff; E-534, U. H.
 4:30 - Bacteriology Seminar; Serodiagnostic Tests on Human Cancer; Alvar Werder; 214 M. H.
 5:00 - 5:50 Roentgenology Seminar; Sideropenic Dysphagia; Dr. Stanley Peterson; M-515 U. H.

Friday, Mar. 8

- 9:00 - 9:50 Medicine Grand Rounds; C. J. Watson and Staff; Todd Amphitheater, U.H.
 10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221 U. H.
 10:30 - 12:20 Otolaryngology Case Studies; L. R. Boies and Staff; Out-Patient Otolaryngology Department; U. H.
 11:50 - 1:15 University of Minnesota Hospitals General Staff Meeting; Ringworm of the Scalp; Dr. Richard Steves; New Powell Hall Addition Amphitheater.
 1:00 - 2:00 Dermatologic Allergy; Dr. Stepan Epstein; W-312 U. H.
 2:00 - 3:20 Dermatology and Syphilology; Presentation of Selected Cases of the Week; H. E. Michelson and Staff; W-312 U. H.
 1:30 - 2:20 Roentgenology-Neurosurgery Conference; H. O. Peterson, W. T. Peyton, and Staff; Todd Amphitheater, U. H.

II. HERNIATED INTERVERTEBRAL DISC

An Analysis of 94 Cases.

William T. Peyton
Donald R. Simmons

The problem of posterior herniation of the intervertebral disc is one which has evoked much discussion and great diversity of opinion in the last few years. This is true not only of methods of diagnosis of the disease, but also concerning the methods of the treatment of the disease, and the results of such treatment. Because there is such diversity of opinion concerning the criteria to be used in diagnosis, the proper methods of therapy, and the results of therapy in the treatment of the disease, we felt that it would be of value to analyze the cases which have been surgically treated at the University of Minnesota Hospitals for herniation of the nucleus pulposus between August 1, 1942 and December 31, 1945. (This period was used because all patients operated previous to August 1, 1942 were previously reported by Peyton and Leven¹.) In addition to the statistical summary, a discussion of some of the controversial opinions concerning this disease that are to be found in the literature will be presented.

In the period extending from August 1, 1942 to December 31, 1945, 94 patients, in whom a diagnosis of posterior herniation of the nucleus pulposus (herniated disc) was made, were operated at the University Hospitals. (This period was used because all patients operated previous to August 1, 1942 have been previously studied and reported¹. Ninety of these were cases of lumbar herniations, and 4 were cases of herniations in the cervical region. Because these 2 groups present quite different problems, especially in diagnosis, they will be considered separately.

Of the total number of 90 cases that were operated for a herniated disc in the lumbar region, 10 (11%) were negative explorations, and 80 (89%) cases were found to have had definitely pathologic intervertebral discs. A disc was not considered to be pathologic unless one or

the other of the following two criteria were fulfilled; first, the nucleus pulposus had ruptured completely through the annulus fibrosus and was lying free in the extradural space (ruptured intervertebral disc); or, second, there was a bulging of the disc and when the annulus fibrosis was opened the nucleus material mushroomed spontaneously into the epidural space. Unless one of these criteria were not fulfilled the procedure was considered to be a negative exploration. These criteria are much more rigid than required by most surgeons, but when either is present, no one familiar with disc lesions would doubt that the disc is pathological. On the other hand the terms "concealed discs" and "protruded discs" are used by some surgeons to designate the condition of discs which they consider abnormal. Whether any of these discs, so designated are abnormal is questionable and certainly there is much room for personal interpretation and speculation on the part of the surgeon who is faced with a negative exploration or the consolation of a pathological disc of this indefinite type. Because of the variation in the disc structure it appears to us to be difficult if not impossible to determine at operation that a disc is abnormal merely by its appearance or its consistency. It is true that the herniated disc has a typical bulging appearance, and a soft, boggy consistency, but these signs are open to so much individual interpretation that they may be quite misleading. In support of the opinion that a pathological disc is either found lying free in the extradural space or that it mushrooms out spontaneously when the annulus fibrosis is opened is the fact that the 10 cases in this series which were considered to be negative explorations in general did not have symptoms and signs as typical of the disc syndrome as those cases in which these findings were present. After inspection and palpation of the disc, we were still so uncertain about its condition that in most of these 10 cases the annulus was opened and some of the disc material was removed. This was done when the disc was bulging or seemed to be of abnormal consistency.

All 80 abnormal discs were found in

the last two lumbar and the lumbo-sacral interspaces. Six (7%) were at the interspace between the third and fourth lumbar vertebrae, 28 (35%) between the fourth and fifth lumbar vertebrae, and 46 (58%) at the lumbo-sacral interspace. This conforms with the experiences of other investigators in that all have found the vast majority of diseases discs in the last two interspaces with a small percentage in the 3rd lumbar interspace and lesions above this level are rare. Smith, Deery, and Hagman² in a series of 100 cases of herniated disc, found that 62 were at the lumbo-sacral interspace, 40 at the 4th lumbar vertebrae and one at the 3rd lumbar interspace. Verbruggen³ in a series of 75 cases found 58% at the lumbosacral interspace, 35% at the 4th lumbar vertebrae and 3 cases at the 3rd lumbar interspace. One case in his series was between the 5th and 6th lumbar vertebrae and in one case Verbruggen found multiple disc lesions.

The disease is much more common in men than in women probably because of the fact that trauma is commonly a precipitating cause, and men are subjected to trauma more frequently than women. The ratio in the cases studied was 60 men and 40 women.

In Table 1 all patients operated for disc lesion are listed in 5-year age groups. All were between 20 and 60 years of age with the maximum number in the 36-40 age group. Thus, we find herniated discs occurring most frequently in that group, that is subjected to frequent trauma, yet of sufficient age to have degenerative changes occurring in the disc. This would suggest that degenerative changes progressive with age may be an important underlying etiologic factor, with the superimposed trauma as a precipitating cause of the herniation. The occasional occurrence of multiple herniated discs would also give support to this view.

In charts 2 through 7 the symptoms presented by all 90 patients operated upon for a disc lesion are summarized. In order to determine whether there was any difference in the symptomatology of disc lesions in the various interspaces, the tabulations were made according to the interspace involved. For a similar reason

Chart 1 - Age Incidence

Ages Years	Disc	Disc	Disc	Total	No Disc at Oper- ation
	at L3	at L4	at L5		
21-25	0	2	5	7	1
26-30	0	2	3	5	1
31-35	2	5	7	14	2
36-40	0	7	13	20	4
41-45	0	5	10	15	1
46-50	3	5	6	14	1
51-55	1	1	0	2	0
56-60	0	1	2	3	0
Totals	6	28	44	80	10

the cases in which no pathological disc was found are also included for comparison. It will be seen that the only significant difference in symptomatology is in the cases in which the herniated disc had caused a paraplegia. It also seems significant that both cases in which paraplegia occurred the lesion was in the interspace between the third and fourth lumbar vertebrae.

A definite history of trauma is commonly obtained in this disease, and of the 80 cases proven to have pathological discs 63 (79%) had a history of trauma. This is higher than the usual figure given by most authors. Bradford and Spurling⁴ state that about 50% give a history of frank trauma. Spurling and Thompson⁵ estimate that 40% give unequivocal histories of trauma, and Verbruggen's³ figure is 62%. In the previous group from this clinic reported by Peyton and Leven¹ 67% were found to have a history of trauma. Most commonly, in our patients, the trauma consisted of heavy lifting or of a twisting injury to the back. Histories of trauma are notoriously unreliable but in many the story is unmistakable. In these cases the patient gives a history of unusual trauma associated with a feeling of something snapping in his back, and with the immediate onset of pain in his low back, and pain immediately or later radiating over the sciatic distribution on the involved side.

As a rule, the onset of symptoms in these cases is very acute, and the pa-

Chart No. 2 - History of Trauma

	<u>Disc at L3</u>	<u>Disc at L4</u>	<u>Disc at L5</u>	<u>Total</u>	<u>No disc found at operation</u>
Definite history of trauma	5	20	38	63	6
Negative history of trauma	1	8	8	17	3
History of trauma not recorded	0	0	0	0	1

ient can give the date of onset and even the time of day that he first experienced pain in his back or in his leg. This sudden acute onset is useful in the differential diagnosis of this syndrome from back and sciatic pain from other causes

since they are much less apt to have an acute onset. A history of acute onset was recorded in 51 (64%) cases; in 12 (15%) the onset was definitely not acute, and in 17 (21%) the rapidity of onset was not recorded.

Chart No. 3 - Onset of Symptoms

	<u>Disc at L3</u>	<u>Disc at L4</u>	<u>Disc at L5</u>	<u>Total</u>	<u>No disc found at operation</u>
Onset acute	4	17	30	51	2
Onset gradual	0	4	8	12	1
No record of acuity of onset	2	7	8	17	7

The duration of symptoms at the time of operation was found to vary from 4 weeks (in the case of a disc with paraplegia) to 20 years. In many cases of long duration it is difficult to determine how long the symptoms have been present especially if the onset of symptoms was not acute. In these cases the patient

has frequently forgotten details of this history. In determining the duration of symptoms it was therefore, frequently necessary to take as the date of onset that time at which the patient was first incapacitated by the symptoms or if this could not be determined, then the date of onset of the sciatic radiation of the pain.

Chart No. 4 - Duration of Symptoms

<u>Duration</u>	<u>Disc at L3</u>	<u>Disc at L4</u>	<u>Disc at L5</u>	<u>Total</u>	<u>No disc found at operation</u>
Under 6 mo.	2	10	15	27	1
6 mo. - 1 yr.	1	1	9	11	0
1 yr. - 2 yr.		4	6	10	4
2 yr. - 5 yr.		7	5	12	3
5 yr. -10 yr.		4	8	12	1
Over 10 yrs.	1	1	3	5	0
No record of duration of symptoms	2	1	0	3	1

The most common symptom of herniated disc is backache, and this backache frequently antedates all other symptoms by a period of time ranging from hours to many years. The back discomfort is usually localized to the lower lumbar spine, and is frequently more severe on the involved side. All of the cases in this series complained of backache, and in most of the cases it was a major symptom. This compares closely with Verbruggen's³ finding that 95% of his cases complained of back pain.

Pain in the area of the sciatic sensory distribution was found to be present in practically every case. There was absence of sciatic pain in only one case. Again, this is in agreement with Verbruggen's³ findings that 100% of his cases had sciatic pain. In most of the cases the pain is present predominantly in the posterior part of the thigh, but in some cases it radiates into the calf, and even into the foot. In herniation

at the lumbosacral interspace, if pain is present in the foot it is frequently over the lateral side of the foot, thus following the sensory distribution of the first sacral root, while in herniation at the 4th interspace it is more typically on the dorsum of the foot and radiates into the great or second toes. The interspace involved may be suspected merely from the history of pain radiation. In most cases, however, the pain is not well localized and other signs must be used to localize the lesion.

Aggravation of the back or sciatic pain or both by coughing, sneezing, or straining is a common complaint, and was present in this group in 65 of the total 80 cases. This symptom has been emphasized frequently and needs no further discussion.

Chart No. 5 - Pain Made Worse by Coughing and Sneezing

	<u>Disc at L3</u>	<u>Disc at L4</u>	<u>Disc at L5</u>	<u>Total</u>	<u>No disc at operation</u>
Aggravation of pain by coughing and sneezing	4	21	40	65	6
No aggravation by coughing and sneezing	0	2	4	6	2
No record of this symptom	2	5	2	9	2

Twenty-six of these patients had a definite history of limping gait because of the pain, and in only 5 cases was it definitely stated that no limp was present. Unfortunately, in 49 of the cases there was no record made regarding this symptom, but a limping gait is a common symptom, in those cases with very severe pain.

Cases of herniated disc typically have exacerbations and remissions of their symptoms. This was true of 69 of the patients in this group, and this compared quite closely with Love's⁶ figure of 85%. Patients frequently dis-

cover that the recurrence of symptoms follow any unusual strain, and are relieved by bed rest, but the symptoms will also frequently disappear in time without any treatment. Because of this response to conservative therapy which has been emphasized by Key⁷ and others, we have made it a practice not to operate on cases of herniated disc during their first attack, unless this attack is of several months duration and the symptoms severe. We have done this because we agree that many of these patients may have a very satisfactory response to conservative therapy and that some of them will have no further exacerbations of

pain. However, if the symptoms are incapacitating over a period of more than two or three months, or if there is a recurrence of symptoms with incapacitation we feel that surgical intervention is warranted even though prolonged non-operative therapy may bring about a remission.

These disc lesions frequently are so completely disabling and most patients can ill afford long periods of complete rest at frequent intervals such as are necessary in the conservative management of these cases.

Chart No. 6 - Exacerbations and Remissions of Symptoms

	<u>Disc at L3</u>	<u>Disc at L4</u>	<u>Disc at L5</u>	<u>Total</u>	<u>No disc at operation</u>
Remissions	5	24	40	69	4
No remissions	1	2	4	7	3
No record of remissions	0	2	2	4	3

Seventy of these (80%) cases were completely incapacitated at some time during their illness. In this study a patient was considered to be incapacitated if he were unable to do his usual work for a period of at least one week. However, nearly all had much longer periods of incapacitation, and the pain was frequently so severe that long periods of bed rest were essential for relief of pain. Except in the occasional case with

paralysis, the only reason for operating these cases is to relieve their pain, and it is necessary for the surgeon to judge whether the pain is of sufficient severity to warrant surgical intervention. A pathological disc without pain is not an indication for operation. Because of difficulty in evaluating the severity of pain in many of these cases, we have placed much weight on the amount of work in arriving at a decision as to whether a patient should be operated.

Chart No. 7 - Work Incapacity

	<u>Disc at L3</u>	<u>Disc at L4</u>	<u>Disc at L5</u>	<u>Total</u>	<u>No disc at operation</u>
Incapacity of at least one week duration	5	24	41	70	5
History of no incapacity	0	2	0	2	0
No record of incapacity	1	2	5	8	5

The physical findings on examination were summarized, and the charts which follow show the incidence of some of the more important findings. In general these results are in agreement with those of other investigators (Smith, Deery, and Hagman; Verbruggen, Love and Walsh). In this summary the cases have been grouped according to whether a disc lesion was found at L3, L4, or L5 with a fourth group in which operation revealed no disc lesion.

This analysis of physical findings according to site of the lesion is made in order to see if there is any significant difference in the frequency of physical signs.

As would be expected the Achilles reflex, the arc of which is chiefly in the first sacral root, is diminished or absent in a significantly greater percentage of discs at L5 than at L4.

However, 5 of the 6 cases in which the lesion was at the 3rd lumbar interspace also had either diminished or absent Achilles reflexes, but in this group are two cases with lesions so large that they produced a paraplegia of all segments at and below the lesion. This tendency for herniations at L3 to be massive probably explains the high incidence of abnormal Achilles reflexes in this group. It is surprising to find that the quadriceps reflexes were recorded as de-

creased in 11 cases with lesions at L5 since the arc of this reflex is in the 2nd, 3rd, and 4th lumbar segments. It is quite probable that in many of these cases this reflex was apparently diminished because of a protective muscle spasm, and that this finding was misinterpreted. For this reason it is very important to make every effort to have the patient completely relaxed when the reflexes are being tested.

Chart No. 8 - Reflex Changes

<u>Quadriceps reflex</u>	<u>Disc at L3</u>	<u>Disc at L4</u>	<u>Disc at L5</u>	<u>Total</u>	<u>No disc at operation</u>
Normal	3	23	34	60	8
Diminished or Absent	3	3	11	17	0
No record	0	2	1	3	2
<u>Achilles reflex</u>					
Normal	1	12	6	19	5
Absent or Diminished	5	15	38	58	4
No Record	0	1	2	3	1

About half of these patients show a definite scoliosis, and most frequently the convexity of the curve is toward the

side of the disc lesion, but occasionally it is in the opposite direction.

Chart No. 9 - Scoliosis

	<u>Disc at L3</u>	<u>Disc at L4</u>	<u>Disc at L5</u>	<u>Total</u>	<u>No disc at operation</u>
List with convexity away from lesion	1	4	5	10) 4
List with convexity to the lesion	0	9	11	20	
No list	0	5	17	22	3
No record of list	5	10	13	28	3

Spasm of the erector spini group of muscles is a common finding.

Chart No. 10 - Spasm of Erector Spini Muscles

	<u>Disc at L3</u>	<u>Disc at L4</u>	<u>Disc at L5</u>	<u>Total</u>	<u>No disc at operation</u>
Spasm side of lesion	3	11	11	25	4
Spasm on oppo- site side from lesion	0	0	3	3	
Bilateral muscle spasm	0	1	7	8	0
No spasm	0	11	9	20	1
No record	3	5	16	24	5

On occasion we have found that the localization of tenderness in the back is the best method of determining the interspace involved by the pathologic disc. If used alone, it may be misleading as a method of localization, and it will be noted in Chart #11 that in a considerable

percentage of cases the maximal tenderness was present at an uninvolved interspace. This test is especially significant if the tenderness is associated with radiation of pain over the course.

Chart No. 11 - Space Tenderness

	<u>Disc at L3</u>	<u>Disc at L4</u>	<u>Disc at L5</u>	<u>Total</u>	<u>No disc at operation</u>
Tenderness at site of lesion	1	19	25	45) 9
Tenderness present but not at site of lesion	1	7	12	20	
No tenderness	0	0	6	6	
No record	4	2	3	9	1

Tenderness along the course of the sciatic nerve is a frequent finding

especially in those cases which have severe symptoms.

Chart No. 12 - Sciatic Tenderness

	<u>Disc at L3</u>	<u>Disc at L4</u>	<u>Disc at L5</u>	<u>Total</u>	<u>No disc at operation</u>
Tenderness on side of lesion	0	15	20	35) 4
Tenderness on opposite side	0	0	1	1	
Bilateral tenderness	0	0	0	0	0
No tenderness	2	4	10	16	1
No record	4	9	15	28	5

Production of pain in the leg, hip, or back by stretching the sciatic nerve is one of the most classical signs

present in almost every case.

These various sciatic stretching

tests include:

1. Straight leg raising test - - The thigh is flexed upon the trunk with the knee in extension.
2. Lesague's test - The thigh is flexed until it forms an angle of 90 with the trunk, and then the knee is extended. In normal individuals it should be possible to extend the leg to an angle of 120 without pain. This test together with the Naffziger procedure described below are extremely useful in conjunction with the straight leg raising test, because there is no movement of the hip joint during the procedure, and for this reason they may help to rule out hip joint pathology.
3. Naffziger's test - The straight leg raising test is repeated but just before the point of pain is reached the foot is forcibly dorsiflexed.
4. Bonnet test - The thigh and knee are flexed on the abdomen and the thigh is then forcibly adducted.
5. Forward bending - The patient while standing attempts to touch the floor with his finger tips while keeping his legs extended. This can be checked by raising the patient from a supine to a sitting position with the legs extended. If the test is positive the patient will experience pain in the back or over the course of the sciatic nerve.

If the symptoms are severe, sciatic stretching tests may be positive bilaterally, although they are usually more marked on the side of the lesion. Frequently in those cases in which sciatic nerve stretching tests are positive, bilaterally, the pain produced by performing the test on the extremity contralateral to the lesion is referred to the involved side. This phenomenon is a dependable sign that a herniated disc is present. In those cases in which it is suspected that the patients' complaints are due to a psychoneurosis one may include, with these true sciatic stretching maneuvers, other tests which forcibly change the position of the leg but do not stretch the sciatic nerve. In the psychoneurotic person, it will frequently be found that these tests cause as much pain as those in which the nerve is actually put under tension.

Chart No. 13 - Sciatic Stretching Tests

	Disc at L3	Disc at L4	Disc at L5	Total	No disc at Operation
Positive on side of lesion	2	15	32	49) 5
Positive on opposite side	0	0	0	0	
Tests positive bilaterally	1	13	12	26	4
Tests negative	0	0	2	2	1
No record	3	0	0	3	0
Pain referred to side of lesion on testing oppo- site side	1	4	9	<u>14</u>	<u>0</u>

Muscle atrophy and muscle weakness was rarely recorded in the records of these patients.

Chart No. 14 - Muscle Atrophy

	Disc at L3	Disc at L4	Disc at L5	Total	No disc at operation
Atrophy present	0	2	5	7	0
No atrophy	1	8	11	20	4
No record of atrophy	5	18	30	53	6

Chart No. 15 - Muscle Weakness

	Disc at L3	Disc at L4	Disc at L5	Total	No disc at operation
Weakness present	2	1	3	6	0
No weakness	0	8	17	25	4
No record of weakness	4	19	26	49	6

Sensory changes were present in 38 cases. A careful delineation of any sensory abnormality is of great importance because the segment or root involved can thus frequently be determined. Occasionally the method described by Keegan⁹ of eliciting hypalgesia by scratching the skin from the hypalgesic zone to the nor-

mal area has been found to be very useful. This is especially true in those cases in which the sensory change is very slight and cannot be obtained by the usual pin prick method.

Chart No. 16 - Sensory Changes

	Disc at L3	Disc at L4	Disc at L5	Total	No disc at operation
Sensory changes present	3	11	24	38	3
No sensory changes	1	11	16	28	4
No record of sensory changes	2	6	6	14	3

Two patients were admitted to the hospital because of paraplegia. It is remarkable that the disc lesion in both of these patients with paraplegia should be at the 3rd lumbar interspace where only 6 (7%) of the disc lesion occurred. However, when this is considered together with the experience of other reports in the literature, it seems to be significant of a tendency for massive herniation to occur in this 3rd lumbar disc. Two cases of herniated disc with paraplegia reported by Voris¹⁰, were herniations at the 3rd lumbar interspace.

Verbruggen¹⁰ reported 8 cases of mas-

sive extrusions intervertebral disc verified at operation, two of which were located at the 3rd lumbar interspace. It would appear, at least from this small group, that the cauda equina compression syndrome is more common in cases of discs at the 3rd lumbar interspace than one would expect from the general incidence of pathologic discs at this interspace.

That the return of function after operation on these cases with severe cauda equina compression is very incomplete was shown by the report of Verbruggen.¹¹ He operated upon 8 cases

and reported the result as excellent in one, good in one and fair in the remaining six. These 6 cases all had residual weakness, anesthesia, or loss of sphincter control of varying severity. Voris¹⁰, on the other hand, reported that the symptoms in his cases were relieved by removal of the disc lesion.

The poor prognosis in these cases may be due to the fact that the paraplegia is usually produced by a sudden compression of the cauda equina. These cases constitute a real emergency, the cauda equina should be decompressed as soon as the diagnosis is made since the amount of recovery is probably inversely proportional to the length of time the cauda equina is compressed. Both cases seen because they had a paraplegia were thought to have cord tumors until a disc lesion was discovered at operation. Although much more extensive laminectomy was done than would have been necessary to remove a herniated disc, this is not a serious matter. Love⁶ has emphasized the importance and the difficulty of differentiating between herniated discs and cauda equina tumors, and has suggested that myelography should be done on all cases suspected of having a herniated intervertebral disc to rule out the existence of a cord tumor. The first of these two patients had a lipiodol myelogram which demonstrated a complete obstruction at the level of the third lumbar interspace, but it could not be definitely determined from the myelogram whether this obstruction was due to an intradural or extradural tumor. Because we had never seen a similar case previously and because the signs presented in this instance were so typical of a cauda equina tumor, the possibility of a herniated disc was considered only lightly. In the second case no spinogram was done, again, because of the classic nature of the findings and because the lesion could be very definitely localized by means of neurologic findings alone. In retrospect, the acute onset of pain in the legs which in one case was associated with trauma, and the subsequent rapid progression of paralysis should have made us suspect the possibility of a herniated intervertebral disc.

Three of the cases in this series were re-operations for a disc in patients who

had had a pathologic disc removed previously, and in all three a herniated disc was again found. In one case the recurrence was at the same interspace, and in two the recurrence was in a different interspace. This incidence of recurrence of a disc at a second interspace 2 in '80 is so much greater than the incidence of disc lesions in the general population of similar age that it suggests that there may be some degenerative change in the intervertebral disc as underlying pathology in cases of herniated intervertebral discs.

In only one of the 90 cases the ligamentum flavum found to be definitely abnormal and in this case it did not appear to be hypertrophied, but there was degeneration of the ligament, its central portion was replaced with caseous material so that when it was first exposed and incised we thought we were dealing with a small dermoid cyst.

The only significant laboratory finding in cases of herniated intervertebral disc is a moderately elevated spinal protein. This is usually between 35 and 100 mg. %. In only 6 patients was it found to be over 100 per 100 cc., and in 3 of these, a complete block of the subarachnoid space was demonstrated either by the jugular compression test or by myelography. The highest level 2000 mgm. % was found in one of the patients with compression paraplegia.

Routine antero-posterior and lateral x-rays of the lumbosacral spine are always taken. Seven of the 90 cases had varying degrees of lumbarization of the first sacral vertebrae, one had a spondylolithiasis, and one had a spina bifida occulta. This is a small incidence of these abnormalities than has been reported by Breck, Hillsman, and Bason¹² in their review of 450 routine lumbosacral x-ray examinations on work applicants. This fact is of considerable significance because it has been stated that pre-existing back instability predisposes to the occurrence of a herniated intervertebral disc.

Deery¹² believes that such instability may be a predisposing factor, and he believes that this is an entirely different

entity from the disc in which there has been no preceding symptom of such low back instability. The analysis of these 80 cases, however, would tend to make one doubt that any of the abnormalities which are evident on roentgenographic examination may be a predisposing cause for this disease.

Narrowing of the interspace involved by the herniated disc was observed in 16 cases, but it was found in an interspace other than that involved by the pathological disc in 8 cases, and in addition it was present in 3 of the cases in which no disc was found at operation. Thus, little reliance can be placed on this finding as a method of localization of the interspace involved by the pathologic disc, although this also has been said to be a reliable diagnostic and localizing sign.

There is considerable difference of opinion as to the need for and the advisability of the use of myelography as a diagnostic aid in this disease, and if myelography is to be done there is no agreement as to the type of contrast media which should be used. Love⁶ recommends the use of air myelography in all cases. Verbruggen³ does not believe myelography is ever warranted, and Key⁷ believes myelograms are no more accurate than a good physical examination. It has been the practice in this clinic to use lipoidal or Pantopogon myelography but only in selected cases. Air myelography was discarded in 1941 because it was felt that the information it gave was too unreliable. Certain patients present such classical symptoms and signs that myelography is unnecessary and they would be operated upon even if the myelograms proved to be negative. In this group it is illogical to do myelographic studies. In other patients the findings are less distinctive, and in these cases the decision as to whether an exploration will be done may depend on the results of a myelogram. It is this type of case in which x-ray studies with contrast media are done. Injection of an irritating media even though it be mildly so, into the subarachnoid space, is not done with impunity, but it is warranted in these selected cases. Furthermore, with the

development of a technique for aspiration of the contrast media immediately following the x-ray examination, most of the cause for objection to its use has been eliminated. It has been possible to remove all or nearly all of the media in almost every case. Myelograms were done in 46 cases with correct diagnosis in 36, incorrect in 7, and in three an interpretation was not possible because the contrast media was injected into the subdural space. Incorrect roentgenological diagnoses were false positives in 5 and in one the roentgenological diagnosis was normal yet operation revealed a large herniation lying free in the epidural space under the first sacral root. In one case the myelogram was positive but the disc was found in a different interspace than that indicated by the myelography. These results of myelography agree rather closely with those of Shinnors and Hamby¹⁴ who found in a series of 47 lipoidal myelograms that there were 34 correct conclusions, 9 false positives, and 4 false negatives.

The surgical procedure followed in the removal of the pathological disc lesions is similar to the technique employed in other clinics. In some cases none of the lamina need be removed, and a satisfactory exposure of the disc can be obtained by removal of the ligamentum flavum alone. It is customary to remove the lower margin of the lamina above and the upper margin of the lamina below the involved interspace. Following this, the dura and nerve root are gently retracted medially, and the disc is exposed for inspection. If the disc is herniated the annulus is incised to allow the nucleus pulposus to mushroom spontaneously into the epidural space where it is grasped with a forceps and removed. The intervertebral is then searched for other fragments. In the last 2 years a Gibson¹⁵ type of dove-tailed bone graft has been used in all cases. Until 6 months ago these bone grafts were taken from the tibia, but in the last 6 months they have been obtained from the crest of the ilium. The grafts are wedged tightly in place between the spinous processes of the vertebrae adjacent to the involved disc while

Chart No. 17 - Myelography

	Disc at L3	Disc at L4	Disc at L5	Total	No disc at operation
X-ray diagnosis of disc	3	17	16	36	5
X-ray diagnosis negative	0	0	1	1	0
Disc diagnosed but at wrong interspace	0	1	0	1	-
Subdural injection of contrast media	0	0	0	0	3
No myelogram	3	10	29	42	2

the patient is flexed at the pelvis to widen the interspinous space and then upon extension the graft is so solidly fixed that it is usually impossible to move it. Bone grafts of this type have been inserted in 45 of these cases after a diseased disc was removed, and similar bone grafts were inserted after negative explorations in 2 cases.

In 51 of the 80 cases the disc was herniated but had not completely ruptured through the annulus fibrosis, and in 29 of the cases it had ruptured through the annulus and was lying free in the epidural space.

Postoperative complications have been infrequent, and generally not severe. There was one death in the group due to pulmonary embolism, two wound infections, and three had loss of normal urinary sphincter control for a period of more than 5 days postoperatively. In 2 of these cases the sphincter disturbances cleared completely before discharge from the hospital, but in one patient who had had a paraplegia and sphincter loss before operation urinary incontinence was still present.

Grant¹⁶, in a survey of the postoperative results on 150 cases, found 52% were back at work with no pain, 37% were working with disability, and 11% were not working. Shinnars and Hamby¹⁴ found in a follow-up study that 54% had some residual leg pain, and 57% had pain when working. Verbruggen⁷ classified his results in 75 cases as excellent (15%), good (68%), fair (11%), and poor (6%).

We have analyzed the results on 43 of the total 90 cases in this group which were operated for herniated intervertebral disc. Only those cases which had been followed in the clinic or seen elsewhere by one of us at least as late as 6 months after operation, were included in the survey because we have discovered that many patients will claim on casual conversation they have no symptoms, but careful cross-examination will reveal that such symptoms are present. Because of these limitations this group of followed cases is only about 50% of the total number. Because for the last 2 years the use of a bone graft has been a routine procedure the total number of follow-up cases was divided into 2 groups depending on whether or not a graft had been used. Since the use of a graft was a routine procedure during this period the only difference in the two groups which would affect the results was the fact that the group in which no bone grafts were used was followed for a considerably longer period of time than the group in which bone grafts were used. It will be seen that there is little difference in results between the 2 groups, and the slight difference that is present favors that group in which no bone grafts were used.

The results have been summarized into 4 large groups, i.e., excellent, good, fair, and poor. Only those cases which had absolutely no symptoms pertaining to the low back or legs were included in the first group designated as excellent results. The second group, or those in

which the result is considered to be good in this tabulation includes the majority of the patients. These patients had some distress such as low back pain, ldg pain, or paraesthesias, but in no case were the symptoms of sufficient severity to cause any incapacity for their usual activity. In many of these cases the patients are doing heavy manual labor every day, and although they have some occasional discomfort it is not of sufficient severity to prevent them from carrying on this type of activity. One case included in this group, however, did have an attack of very severe back pain 2 months after operation and was hospitalized for 3 weeks. It is possible that he should have been included in the third group, but he has now been followed an additional year without recurrence of any symptom more severe than occasional mild low back pain which has never interfered with full work capacity.

In one case that had positive findings at operation, and in 2 of the cases in which no disc was found, the results were considered to be fair, inasmuch as their symptoms were of sufficient severity so that they were definitely incapacitated. In the case of the patient in whom a pathological disc was found there is considerable doubt as to whether these symptoms are related to his low back, but because of his incapacity he was placed in this group. In 2 of the cases in whom a pathological disc was found at operation, the results were definitely unsatisfactory. One of these cases had a paraplegia preoperatively and he still has marked weakness in his legs, diminished sensation below the third lumbar dermatome and poor sphincter control. The other patient is one who has had a recurrence of exactly the same symptoms she had before operation, and these symptoms are of the same severity. In addition one case considered to be a negative exploration is a definitely poor result.

It will be observed that in those cases in which a pathological disc was not found at operation the results, at least in this small group, appear to be definitely worse than the results are in that group in which a pathological disc was removed. The most common problem in differential diagnosis in this disease and

the one that probably presents the greatest difficulty is the differential diagnosis between psychoneurosis and a pathological disc. Those patients with a psychoneurosis relating to the low back may mimic the symptoms of a herniated disc and present such similar physical signs so closely that a differentiation is virtually impossible. For this reason patients suspected of having an intervertebral disc lesion are seen by the neuropsychiatry staff before operation, and are carefully evaluated to rule out psychogenic disease. Not infrequently a patient is seen who is thought to have a pathologic disc together with a psychoneurosis relating to the low back. In this case the problem of deciding whether this patient should be operated becomes even more difficult. The presence of a psychoneurosis does not necessarily signify that a patient with a pathological disc should not be operated but these patients require a very careful psychiatric evaluation. At times surgical intervention to remove a pathologic disc may be necessary before any successful attack can be made on the psychogenic problem and in these cases it should be recognized that if surgical intervention is indicated, it should be combined with psychotherapy. Certainly, in those patients in whom the symptoms are on a purely psychogenic basis, an operation on the back only serves to further focus attention to this area, and as a result the symptoms are made worse by the operative procedure.

The results of operations for herniated intervertebral discs in our experience are satisfactory even in not perfect. If the patients on whom the operation is to be done are well chosen the results are very satisfactory. The large majority do not have incapacity which was present before operation, although annoying complaints may persist.

Of the total of 94 patients in this group, 4 were operated with a diagnosis of a lateral herniation of a cervical intervertebral disc. Although herniations of the cervical discs have been recognized for many years, the syndrome of lateral herniation of these discs

Results Following Operation

	<u>No Bone graft used</u>	<u>Graft used</u>	<u>Total</u>	<u>No disc found at operation</u>
TOTAL CASES	17	22	39	4
<u>General Results</u>				
Excellent	4	5	9 (23%)	1
Good	11	16	27 (70%)	0
Fair	1	0	1	2
Poor	1	1	2	1
<u>Back Pain</u>				
Present	11	17	28 (72%)	3
Absent	6	5	11 (28%)	1
<u>Sciatic Pain</u>				
Present	6	7	13 (33%)	2
Absent	11	15	26 (67%)	2
<u>Impairment of Work Capacity</u>				
None	15	21	36 (92%)	1
Slight	0	1	1	1
Moderate	1	0	1	1
Severe	1	0	1	1
<u>Paraesthesias</u>				
Present	7	9	16 (41%)	1
Absent	10	13	23 (59%)	3
<u>Weakness in Leg</u>				
Present	1	2	3	1
Absent	16	20	36 (92%)	3
<u>Sensation</u>				
Normal	13	13	26 (67%)	3
Impaired	4	9	13 (33%)	1
<u>Sciatic Stretch- ing Tests</u>				
Positive	0	1	1	0
Negative	17	21	38	4
<u>#Quadriceps Reflex</u>				
Absent	0	0	0	0
Diminished	6	3	9	3
Normal	11	19	30	1
<u>##Achilles Reflex</u>				
Absent	12	17	29	1
Diminished	3	1	4	1
Normal	2	4	6	2

#In only one patient was a quadriceps reflex diminished when it had not been diminished before operation. In two patients the reflex was normal following surgery when it had been diminished before surgery.

##In four patients the Achilles reflex was diminished more than it has been previous to operation. In one case this reflex was normal following operation when it had been diminished before surgery.

has been recognized only recently. Those cases of cervical herniated discs which were recognized previously were cases in which the herniated disc gave symptoms simulating a cord tumor. Nearly all of these lateral herniations occurring in the cervical region occur at either the interspace between the 5th and 6th, or the 6th and 7th cervical vertebrae. Spurling and Scoville¹⁷ in 12 cases of cervical herniations found the lesion at the 5th interspace in 8 patients. In one case both interspaces were involved. In patients with involvement of the 6th cervical root the biceps is weak and there are frequently sensory changes over the thumb and radial side of the hand. In patients with involvement of the 7th cervical root (disc at interspace between the 6th and 7th cervical vertebra) there is weakness of the triceps with sensory changes over the index finger and occasionally the thumb and ring fingers. There are other signs which are helpful in arriving at a diagnosis of cervical herniated disc. Tenderness over the spine is frequently present, and the foraminal compression test is a valuable aid in diagnosis. In this test the head is tilted toward the side of the lesion and pressure is then applied to the top of the head. Typically, this procedure will reproduce the patient's symptoms. These patients frequently keep their heads tilted away from the side of the lesion because they have discovered that this will give relief of pain.

Roentgenological examination frequently shows narrowing of the involved interspace with severe arthritic changes in the adjacent vertebra.

Of the 4 patients in this group, 2 were found to have pathological discs, and 2 were considered to be negative explorations. (The same criteria were applied in the cases of cervical discs as were used for lumbar herniations.) In both cases in which a pathologic disc was found it was at the interspace between the 6th and 7th cervical vertebrae.

Both of the patients in whom a pathological disc was found had diminished triceps reflexes on the involved side and definite weakness of the triceps on this side. One patient had sensory impairment

over the index finger, and the other had diminished sensation over the thumb and index finger. One case had a very definite history of injury, but in the other case no definite history of injury associated with the onset of symptoms could be obtained. The latter did very heavy work, however, and it is quite possible that he might have overlooked a traumatic episode. In both cases there was pain in the shoulder, arm, and hand. Both noticed that the pain was worse when the head was flexed to the involved side. One of these cases had pain in the left side of the chest which was made worse by exercise, and could have been rather easily mistaken for pain of cardiac origin, especially since it was associated with pain in the left arm. Semmes and Murphy¹⁸ have shown that these patients may be diagnosed as having cardiac disease because of the striking similarity of symptoms in the two diseases.

Of the 2 cases that were considered to be negative explorations, one probably had an early amyotrophic lateral sclerosis, and the other was probably due to a chip fracture of one of the vertebral facet with recurrence of pain following removal of this bony fragment due to arthritic bony spurs at the side of the fracture which gave nerve root compression. Both of these patients had symptoms and signs which were typical of a herniated cervical disc, and in both cases lipoidal myelograms showed deformities consistent with a herniated disc. Myelograms were not done on either of the patients in whom a pathological disc was found.

None of these four patients have been followed for a long enough period of time to warrant making any conclusions concerning the operative results. The two patients in whom pathological discs were found were free of pain, and doing their usual work without difficulty when last seen.

Conclusions

1. The symptoms, physical findings, and operative results have been studied in a group of 94 patients upon whom operations were performed for hernia-

ted intervertebral discs.

2. Return of function has been poor in those patients in whom there was a massive protrusion of an intervertebral disc with a resulting cauda equina compression syndrome.
3. The majority of the patients in this group had residual symptoms following operation but they are not incapacitated for their usual occupations. Thus, we consider that the results are satisfactory but not perfect.
4. Psychoneuroses may mimic all of the symptoms and physical findings of herniated intervertebral disc, and we found it to be the most common and most difficult problem in the differential diagnosis of this disease.
5. Four cases have been operated for a herniated cervical disc, and in 2 of these a pathological disc was found. The symptoms and signs presented in these cases were discussed.

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III. GOSSIP

Showing lantern slides is an art and science. If they are not coordinated with the text, they should be shown at the end or the beginning of the lecture; if they are coordinated with the presentation, they should be left on the screen only during that period in which appropriate remarks are being made concerning them. Slides should not contain so much material that it is impossible to read it from the back of the room. It is not good form to read the lantern slide message for the group, as this implies that they cannot do it for themselves; there are differences in reading speeds and the audience may be way ahead of the speaker (usually). This does not mean that you should not have material on the slides which illustrates your points, but it should not be solid "reading" material. A speaker must decide in advance whether he wishes to present evidence or conclusions. When Dr. T. Duckett Jones was here for the Clarence Jackson Lecture on "Rheumatic Fever" he decided to present conclusions, therefore he showed just a few slides. In presenting lantern slides, the content should be memorized so that the speaker does not have to turn his back to the audience, as speaking to the wall is always unpopular. Avoid scratching the screen with the pointer; some of our best screens have been ruined in this way and it sends shivers up and down the audience. Those who use the electric pointer (spotlight) should not play with it when it is not in use as it is disconcerting to "watch the little dot travel around the room." The worst fault is to leave the slide on the screen and then speak about something else; to make matters worse, some speakers call for the next slide without referring to the one on the screen. Another complaint concerns speakers who flash slides too rapidly without giving them any special attention. Good slides with good material on them properly presented are an asset; poor slides or those improperly presented may detract from what is otherwise a good lecture....In teaching physicians who have a medical background, and most physicians have a fairly good knowledge of most of the ordinary concepts of medicine, it is wise to develop the presentation from the standpoint of "situations". If you present pathology or

bacteriology you are expected to review the whole subject and to show examples; an outline is followed so that the relationships are established and the average physician enjoys this type of presentation because of the recall features involved. A clinical lecture approached in textbook style may fall flat because of the large amount of "evident" material presented, although a well prepared clinical presentation on a special subject may be well received. For the average listener the subject matter is best approached from his standpoint. Example: Lecture on Syphilis of the Central Nervous System. There are at least three situations in which a physician comes in contact with this problem. 1. Differential diagnosis in an obvious disease of the central nervous system; 2. Discovery of a positive blood test for syphilis which is rejected and still found positive. A physical examination including a check of the central nervous system; 3. Patient under treatment for syphilis requires periodic checks of the central nervous system. How is this done and how does the result of the examination influence treatment? Most clinical problems are best developed in this way....It is not wise to hand out mimeographed material in advance for the audience to read while you speak. In the earlier days of our staff meeting we did this and the result was not good. If the group is supposed to follow a lecture at the same time that they read, the majority will read for a time and then give up, much like the lantern slide situation....When extemporaneous remarks are transcribed, most of us are amazed at what we said. It may have been effective at the time but we make different types of mistakes when we speak extemporaneously and when we read manuscript.....There are few people who can sit longer than one hour, especially the first hour in the morning when most program planners decide to go through until mid-morning before recess is called (coffee trouble). The ideal plan is to give 10 minutes off every hour, ask the audience to leave the room and take a stretch. Smoking during class detracts from the audience attention; altho smokers and non-smokers are each supposed to keep the others in mind.....