PROJECT REPORT

TITLE OF THE PROJECT: *ANTERIOR CERVICAL MICRODISCECTOMY WITH AND WITHOUT FUSION A COMPARATIVE STUDY.*

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PROGRAMME:..... *M.Ch NEURO SURGERY*

MONTH & YEAR
OF SUBMISSION:.. *NOVEMBER 1996*.....

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CERTIFICATE

I, Dr. SAI SUDARSAN .....hereby declare that I have actually performed all the procedures listed/ carried out the project under report.

Signature .....

Place : TRIVANDRUM

Name in SAI SUDARSAN .....

Date : 8.11.96 capital letters

Forwarded. He has carried out the minimum requirement of procedures / etc.

Signature

Head of the department

8/11/96.

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DR. SAI SUDARSAN.

AIMS OF THE STUDY

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So far there has been no clear consensus regarding the surgical management of cervical spondylosis. The treatment so far has been individualized. The controversy whether anterior surgery or posterior surgery is better has not yet been solved. However for a single level disc lesion anterior discectomy is better than posterior decompression(19). Again in anterior procedure there is no uniform agreement whether interbody fusion is needed or not.

The present study is aimed at proposing a surgical modality which is better when compared to all existing anterior procedures.

The aim is based on following factors.

1. To find out whether there is any arrest of clinical progression of the disease process with surgery i.e., how many people improved and how many deteriorated after surgery.
2. To find whether there is any difference in the surgical outcome among the various operative procedures.
3. To find the radiological changes in patients who underwent fusion and to compare X-ray findings with those in whom fusion was not done and to correlate with clinical outcome.
4. To find out any factors predicting which patients require

fusion.

5. To compare the results with those of studies in the western literature.

6. To study the details of complications including those related to the graft.

7. To propose any guidelines for surgical management of cervical disease in the Indian context.

INTRODUCTION

INTRODUCTION

Cervical spondylosis is a disorder characterised by increasing degeneration of the cervical intervertebral discs with subsequent changes in bones and soft tissues. It is the most common spinal disorder affecting people over fifty years of age(12). Most people in this age group have cervical spondylosis without any symptoms apart from a reduced mobility of the cervical spine. In some cases however, the nerve roots and spinal cord are affected resulting in cervical spondylotic radiculopathy and/or myelopathy. For single level disc disease anterior surgery has been widely accepted(19). But so far there has been no consensus regarding whether the discectomy should be followed by a interbody fusion or not. Very few studies have been done comparing the results of surgery with and without interbody fusion and there has been no significant difference in the outcome.

In our study we have analyzed the results retrospectively and have compared the outcome in cases with and without interbody fusion. The group of interbody fusion has been further divided into two, basing on the type of fusion and the results were analyzed (Cloward Vs Smith Robinson).

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Cervical spondylosis is a chronic degenerative disease of the spine primarily affecting the discs(12). Bone and soft tissues are affected subsequently. There is a progressive decrease in the degree of hydration of the intervertebral disc with age, beginning in the third decade(10). This is associated with a decrease in the mucopolysaccharide content and an increase in collagen, which in turn results in loss of disc height, disc fibrosis and annular weakening. The adjacent vertebral bodies approximate one another as disc narrowing occurs resulting in osteophyte formation.

The reason why osteophytes are formed is not known, but it may be related to abnormal (uneven) movement in the affected areas, which is associated with disc degeneration and appears to be the forerunner of osteophyte formation(10).

In simpler terms osteophyte formation may be the body's attempt to stabilize a joint that is no longer functioning normally. Three different anatomic joints may be involved in this process, the paired zygapophyseal joint posteriorly, intervertebral disc anteriorly and the paired neuro-central joints of Luschka(10).

PATHOPHYSIOLOGY AND PATHOLOGY

Spinal Canal:

There is a consensus that the dimensions of the typical spinal canal are sufficiently ample to tolerate a considerable degree of spondylotic hypertrophy without causing cord compression(13). The luminal tolerances of the canal are quite variable through out the extent of the cervical spine. In the cranial to caudal direction the mid sagittal aspect of the canal presents a funnel shaped profile. The cord occupies only one half of the canal at C1. A critical narrowing commences at C4 and at the C5 - C7 level, the cord occupies three fourths or more of the canal space(44).

As already mentioned the initial lesion is the deterioration of the intervertebral disc. The degeneration of the disc is insidious and is often asymptomatic unless suddenly exacerbated by a traumatic stress. The pathology is first noticed in the nucleus pulposus as it looses its ability to retain water and becomes more fibrous(44). A consequent shrinkage of the nucleus pulposus relieves the normal intradiscal pressure and leads to a collapse of the surrounding fibers of the annulus. The central annular lamellae buckle inward and the external concentric bands bulge outward giving the first indication of compression to

the canal space. Due to cervical lordosis, the normal annulus is thickened anteriorly. So the effect of its collapse is greater in the disc region.

The interdependence of all the components of the motion segment unit is perhaps nowhere better illustrated than in the sequence of events leading to the fully developed spondylosis with the loss of disc space(44). Two additional degenerative events involving the vertebral bodies may ensue. First the greater approximation of the bodies leads to a reactive hyperostosis that expands the adjacent rims, causing an increase in the body diameter at the level of the involved disc. On the dorsal expansion, a hard so called spondylotic bar develops. Second, the abnormal body approximation causes the uncinate process to further override its apposing surface and destroy the interposed uncovertebral joint space(44). Thus the disease process is a regional progressive encroachment of the hypertrophic hard and soft tissues into almost all circumferential aspects of the spinal canal and foraminal openings, ventrally from spondylotic bar formation, ventrolaterally from hypertrophy of the uncovertebral joints, dorso-laterally from facet joint hypertrophy and dorsally from thickening of the ligamentum flavum. Contrary to what might be expected, the most restrictive AP diameter does not occur between the

hyperostosis of a given segment and its respective neural arch structure, but between the hypertrophic growth from the inferior dorsal rim of a vertebral body and the superior lip of the neural arch of the next inferior vertebra (16). In an attempt to devise diagnostic standards, a consensus has been established that AP canal measurement of 12 mm is the critical diameter(6,13).

Medullary ischemia:

The topographic relations of the medullary and radicular vessels are such that they are quite vulnerable to both foraminal and central spatial constrictions and a pressure induced neuro ischemia may be the major factor of cervical spondylosis(44). Throughout its entire length the substance of the spinal cord is supplied by three longitudinal arteries that are regionally fed by medullary vessels of variable segmental origin. The two smaller dorsolateral arteries supply only the dorsal funiculi and the extremities of the dorsal horns. The larger anterior spinal artery supplies 60-75% of the cord tissue through its direct sagittal(sulco commissural) branches and its indirect contributions to the vasa corona or vascular plexuses of the leptomeninges that ensheathes the cord. The mid sagittal position of this vessel not only increases its own vulnerability to direct compression by degenerative

hypertrophies, but its larger, fewer and therefore more significant segmental medullary feeders are exposed to the whole range of ventral encroachments from the foraminal opening to the mid ventral surface of the cord(23).

The anterior medullary artery is found at the greatest frequency at the level of C6(11). The cervical anterior spinal artery is also supplied from intracranial branches of the vertebral arteries superiorly and from upper thoracic medullary arteries inferiorly. Thus the anterior vascularity of the cord can be divided into rostral cervicocranial and caudal cervicothoracic arterial dominions(38).

When the above information is considered in correlation with the variant configuration of the cervical spinal canal, it is seen that risk to the functional integrity of the cord is compounded in the lower cervical region C4 - C7. Not only is the cord more liable to direct damage from hypertrophic changes in this area but the greater frequency and therefore vulnerability of the segmental supply to the anterior spinal artery also occurs in this zone. To add further vascular insult to mechanical injury the atherosclerotic changes are frequently evident in the lower cervical arteries than in the other regions of the cord(20).

Kinetic aspects:

The vertebral structures forming the spinal canal do not move uniformly with the dura and its contents. In flexion and extension there is a degree of translation between adjacent vertebrae that brings the posterior inferior margins of a superior vertebral body close to the next inferior vertebral arch(44). The dural AP diameter is normally reduced by 2mm-3mm in flexion and the situation may dramatically exacerbate an already pathologically reduced diagonal diameter of the canal (29).

The dura and cord are tethered at both ends of the spinal canal in addition to having a degree of fixation at the foraminal exits. The length of the cervical spine may increase as much as 2.8 cms when brought from full extension to full flexion with the greatest degree of variance noted in the C5 region(5). Thus in flexion an increased tension in the cord would force its ventral surface against a translationally reinforced encroachment of a spondylotic bar. The AP diameter of the cord is then reduced, with direct pressure bearing on the anterior column of the cord and an indirect intramedullary pressure affecting the lateral columns. In extension, the ventral pressure on the cord may be reduced. but consequent increase in the AP diameter of the cord may enhance pressure from dorsal

hypertrophic elements(44).

The lateral (radicular) phases of spondylotic changes may be markedly affected by lateral flexion of the cervical spine. As the superior inferior dimensions of the foramina are much altered in lateral flexion, a foramen that is already compromised by AP encroachments related to uncovertebral and neural arch joint hypertrophies may exhibit dramatic and diagnostic radicular symptom enhancement or relief by the appropriate direction of lateral flexion relative to the side of the lesion(41).

It is apparent from both clinical and experimental studies that there are multiple factors involved in the pathogenesis of cervical spondylosis. Most patients with this disease present with a variation of the anterior cord syndrome without loss of the posterior column modalities of position and vibration sense. This would indicate that early in the disease the major pathological entities are anterior cord compression and ischemia in conjunction with a congenitally narrow cervical spinal canal. Most likely a number of other intrinsic factors within the spinal cord occur, including blockage of axoplasmic flow, distrotion of the cord tissue and stretching of the intrinsic transverse terminations of the anterior spinal artery do have a role in the pathogenesis of Cervical Spondylosis.

NATURAL HISTORY

The report of Clark and Robinson in 1956 provides the first clear view of the natural history of cervical spondylosis(8). They observed that once the disorder is recognized complete remission to normality never occurred and spontaneous regression of neurologic deficits were highly uncommon. Sensory and sphincter changes tended to be transient, suggesting regression but motor changes were likely to persist and progress over time. When conservative treatment was provided, improvement occurred in half the patients.

Lees and Turner in 1963 found that the behavior of the disease was the same whether present for more or less than 10 years(21). There was an initial development of symptoms followed by a static period as one of improvement. In those with disease of more than 10 years, one or more additional shorter periods of exacerbation followed in time, each yielding a greater deficit than originally present, but each episode of progression was again followed by a longer steady state or one of improvement. They established that cervical spondylosis is a disease with a lengthy clinical course marked by long periods of non-progressive disability, steady deterioration occurring only exceptionally.

Nurick's report in 1972 confirmed the findings of Lee

and Turner(27,28). Rowland found that complete remission to normalcy never occurred and spontaneous regression was unusual. The common set pattern occurring in 75% of their cases was one of a series of episodes of new signs and symptoms. In two thirds of these, there was an ongoing deterioration between episodes, whereas in the remaining third the condition stabilized between the periods(34).

Symon and Lavender in 1967 challenged the benefits of conservative therapy. They noted that majority of cases had a steady progressive course of deterioration instead of a more benign stepwise course described by Lees and Turner(37).

Philips in 1973 found that the conservative treatment resulted in improvement in only about a third of cases. When treatment results were related to the duration of symptoms, improvement occurred in about half with symptoms far less than 1 year, in 40% with symptoms between 1 and 2 years and in none with symptoms for more than 2 years(31).

La Rocca et.al propose that a patient presenting without major deficits as signs of worsening should be treated conservatively and observed over a period of time. Early surgical decompression with or without stabilization as dictated by the specific morbid anatomy is probably more in order for patients who are moderately or severely

disabled when first seen(16).

However, the information regarding the natural history of cervical spondylosis currently available does not permit precise prognostication.

CLINICAL PRESENTATION

Discogenic Pain:

Headache and neck pain are common symptoms of cervical spondylosis. The headaches are usually of muscle contracting type starting around the occiput and are often exacerbated by neck movement, usually extension and may be due to increased impingement of posterior longitudinal ligament. The neck pain often radiates into the medial scapular area, the so called silver dollar sign(10). This is referred pain from the degenerative disc space brought on by stimulation of the sinu-vertebral nerve fibers in the annulus fibrosis and in the anterior and posterior longitudinal ligaments.

Radiculopathy:

The most common symptom that brings a patient to surgery is radiculopathy(10). This may be in the form of pain down the arm in a dermatomal distribution, numbness or tingling in a dermatomal pattern and/or motor root involvement producing weakness and wasting of muscles supplied by the affected nerve root. In the more acute cases of radiculopathy the clinical examination usually correlates

well with the affected level of cervical spondylosis(10). In this group there is often an episode that may be attributed to the onset of pain and an accompanying component of soft disc herniation. In the more chronic radiculopathies, there is occasionally spondylosis in two or more adjacent levels and on examination, more than one root may appear to be involved. These chronic radiculopathies are usually activity related and often improve with immobilization of the neck. Determining which level to treat requires careful judgment(10).

Myelopathy:

The three most common initial symptoms of spondylotic cervical myelopathy are weakness and clumsiness of hands. dysesthesia and weakness of hands and dysesthesia in the hands with weakness of the lower extremities. The patient may describe this as leg cramping or stiffness of gait. Posterior column symptoms are common and there may be difficulty in walking(10). Accompanying radiculopathies may be present as well as lower motor neuron signs of atrophy and hyporeflexia in the upper extremities. The patients often will have significant associated neck pain, perhaps severe enough that they resist any neck movement during examination(10).

IMAGING

Plain film radiography:

The evaluation of cervical spondylosis begins with a series of anteroposterior, lateral and oblique films of which the lateral view is the most important. . One looks for height of the disc space and for bony spur projecting posteriorly into the spinal canal. The significance of intrusion into canal must be assessed in relation to the size of the canal (14). The anteroposterior diameter is measured as the shortest distance between a vertebral body or bony spur and the spino-lamellar line. Generally an anteroposterior diameter of 12 mm is considered by most authors as the lower most limit of the normal in the lower half of the cervical spine(22). To avoid the magnification factor a ratio of the anteroposterior diameter of canal to that of the vertebral body at the same level has been devised. It is called Pavlov's ratio and is normally about 1(42). A value of 0.8 or lower than that indicates an abnormally small bony canal. The antero-posterior and oblique views are best suited to evaluate the intervertebral foramina and are thus important in assessment of spondylotic radiculopathy.

Myelography:

The contents of the spinal canal, more specifically the spinal cord in cervical spondylosis cannot be seen on plain films(22). The injection of intrathecal contrast material (myelography) allows depiction of the cord. In the past two decades water soluble contrast agents and more recently non ionic agents, iopamidol and iohexol, have been introduced for this purpose. Here again the lateral view is most helpful in assessing the cord and bony intrusions into the canal. Myelography may be followed with computed tomography which augments the value of the both .

Computed tomography:

With its cross sectional views, CT scanning provides significantly more information regarding the size and shape of the spinal canal than does the plain radiograph. The size and direction of bony spurs are clearly depicted. Computer programs supplied with modern scanners permit the reformation of axial slices into sagittal and coronal images, thus further enhancing the value of the procedure. Recently computer programs have become available which permit three dimensional reformatting of the axial images. CT scanning however is by and large unable to depict the spinal cord or other soft tissue structures in the spinal canal to the degree necessary for the evaluation of the

patient with this disease(14).

CT Myelography:

The combination of intrathecal contrast enhancement with CT scanning permits the visualization of bony details and of soft tissue structures in the spinal canal in exquisite details permitting the radiologist to evaluate the compression of the spinal cord and to quantitate it by level. It permits visualization of the spinal cord in the axial plane , relates its size and shape to the size and shape of the spinal canal and at the same time depicts the bony detail which is important in planning a surgical approach. It is possible to use a lower concentration of contrast material for CT myelography than for a conventional myelogram, and thus CT myelography is safer as well as more informative. Penning et al, using CT myelography measured the cross sectional area of the cord in a series of patients with cervical spondylosis. They found that symptoms of the disease appear after cord has been reduced in size by 30% or to less than 60 mm^2(24).

Magnetic Resonance Imaging:

This is the newest imaging modality in neuroradiology and it provides information which the other modalities cannot offer. In many centres it has nearly eliminated myelography because it is non-invasive and allows precise

definition of the pathogenic entity. Soft disc herniations can be precisely localized with MRI. The foramina and intervertebral discs are well demonstrated and nerve root compression can often be appreciated. Sagittal and axial images exclude intrinsic or extrinsic cord lesions. Sagittal flexion and extension films demonstrate the mechanisms of neural compression while directly visualizing the spinal cord. While T1 weighted images identify anatomic detail, T2 weighted images identify pathological changes with in the spinal cord. MRI scanning can visualize intrinsic spinal cord pathology like syringomyelia, hematoma, edema, myelomalacia, cystic necrosis, infarctions and tumors(14).

Thus a combination of MRI and plain radiography of cervical spine in flexion and extension results in high percentage of correctly diagnosed spinal canal stenosis, herniated disc and intradural lesions , than that can be achieved with CT myelography.

MRI evidence of increased T2 signal intensity has been shown to result from myelomalacia, demyelination, gliosis or micro cavities. This abnormality diminished post operatively in patients who improved clinically. It remained unchanged or increased in those who did not improve or had worsened(1).

Post operative MRI is useful in distinguishing

mechanical compression from intrinsic cord damage or atrophy.

CONSERVATIVE MANAGEMENT

Non operative treatment modalities should be tried for every patient, unless the patient meets one or more absolute criteria for surgery.

Immobilization:

Micromotion of a nerve root over a protruded disc or osteophyte results in persistent nerve root irritation and presumably increases the degree of root swelling and possibly even inflammation, all of which can result in prolongation of pain and other neurological symptoms. The neck motion is restricted in a neck collar or an orthosis and root motion will also be minimised(5).

Traction for root symptoms:

Cervical traction provides some degree of transient neck immobilization and relieves pressure on nerve roots by opening the neural foramina. Traction may be very effective for the relief of neck and radiating pain and some sensory symptoms especially when they are of recent onset and intermittent in character. However traction is not indicated for the relief of myelopathy(43).

Rarely in acute situations, bed rest in conjunction with traction is helpful. When properly applied, traction at

bed rest may be tolerated for many hours or days and may be of considerable benefit.

Physical therapy:

Physical modalities like ice, heat, ultrasound and gentle massage all may help to relieve neck and shoulder girdle pain related to nerve root irritation. Forceful neck manipulation should be avoided. Traction during physical therapy should be useful. Physical therapy is also beneficial in the restoration of motor function following root compression treated with or without surgery. It is also helpful in retraining a patient with a myelopathic gait disturbance(43).

Medications:

At least four categories of medications are useful in the treatment of patients with neck and root pain - analgesics, non steroidal anti inflammatory drugs, muscle relaxants and in some situations corticosteroids. These medications may be used together. The specific type of medication and frequency of use are determined by the severity of the patient's pain.

Patients with chronic neck and cervical nerve root pain may be helped by a transcutaneous electrical nerve stimulation. The exact mechanism of action is not known(25).

Avoidance behaviour:

Certain habits of posture or position in the work place can aggravate or perpetuate pain in a patient with cervical spondylosis. Bifocal lenses may lead a patient to hyperextend the neck and full frame reading glasses can prevent this problem. Cradling the telephone receiver between ear and shoulder is a habit to be avoided. Carrying a shoulder bag leads to involuntary corresponding tilting of the upper body and neck. Carrying a heavy bag puts traction on the arm. This traction may be transmitted to the neck and the nerve roots(43).

Timing:

What constitutes a fair trial of non surgical therapy?

In general if a trend to improvement is not evident within 4 to 6 weeks of intensive therapy, a patient probably will not improve with further non-surgical treatment and surgery should be considered(43).

SURGICAL MANAGEMENT

In most patients cervical disc disease and osteophytic disease are not life threatening and surgery for the neurological conditions related to these spinal disorders is elective.

Absolute Indications for Surgery(43)

1. Severe intractable pain.

2. Progressive weakness and sensory deficit.

The prognosis for recovery of motor function is worse, the longer the weakness has been allowed to persist and when it is more severe (particularly when associated with muscle atrophy). Persistent and significant deficits of pain sensation, light touch and joint sensation should not be left untreated far too long, lest they become permanent.

3. Clinical evidence of spinal cord compression.

Prompt and effective decompression of the spinal cord often is followed by some improvement although depending upon the severity of symptoms. Complete reversal of symptoms frequently does not occur.

4. Very acute onset of severe deficit.

The recovery potential of neural tissue subjected to acute compression is significantly worse than the potential for recovery with equally severe but very gradual compression. Hence decompressive surgery is indicated at the earliest more so far myelopathic deficits.

Relative Indications for Surgery(43)

1. Chronic or frequently recurrent episodes of pain, motor or sensory symptoms.

2. Unacceptable lifestyle due to activity restrictions necessary to minimize symptoms.

3. Unacceptable lifestyle due to the need for medications,

which may have undesirable side effects.

4. Failure of non operative treatment.

Relative Contraindications for Surgery(43)

1. Advanced age.

2. Poor general health.

3. Spondylosis with other neurological disorders.

Patients with multiple sclerosis or amyotrophic lateral sclerosis may also have osteophytes that might contribute to the myelopathic picture. Electrodiagnostic studies may be of some help in sorting out a difficult problem of this nature.

4. Cord atrophy due to end stage myelopathy.

Operative management:

A number of factors must be considered in selecting the appropriate operative procedure, including the location of maximal neural compression, the presence of deformity or instability, the potential morbidity and surgeon's experience(39).

Anterior versus Posterior approaches:

Analysis of the literature regarding spondylosis does not demonstrate conclusively the superiority of either the anterior or the posterior approach(7). However, no truly comparative prospective trial has been performed. Instead successful surgery depends more upon proper patient selection and selection of a procedure that will provide

optimal decompression of the nerve root or spinal cord. Under these circumstances, an improvement rate of 70% can be achieved(18). In most patients with cervical disc disease and spondylosis the compressive lesion lies anterior to the nerve root or spinal cord.

Anterior approach:

Before the early 1950's the routine surgical approach for symptoms produced by cervical spondylosis was posterior. The need far easier access to anterior compressive structures led to development of the anterior approach(40).

This approach was developed and popularised in the early 1950s. Bailey and Badgley performed an anterior cervical stabilization in 1952 for a patient suffering from a lytic lesion of C4 and C5 vertebrae(2). In 1955, Robinson and Smith described an operative technique for stabilizing a pathological cervical segment utilizing a horse shoe shaped graft(33). Cloward with no knowledge of the work done by others first published his technique of anterior disc excision and direct removal of compressive structures in 1958(9). The primary difference between the Cloward procedure and that of Robinson and Smith is not the configuration of graft constructs(40). The Cloward technique emphasizes direct visualization and removal of compressive structures(9), where as Robinson and Smith felt

that the removal of these offending structures was not necessary and that posterior and postero lateral osteophytes will be resorbed once stabilisation has been achieved(33). Utilization of operative magnification allows better visualization of neural structures and easier removal of compressive lesions(3).

Surgical technique:

The anterior approach to the cervical spine is relatively safe, technically easy and relatively blood less and utilizes natural anatomical planes(36). Positioning of the patient is very critical. Traction helps to stabilize the spine in a neutral position. Distraction of the disc space can be obtained by adding more weight at the time of graft insertion or a vertebral spreader may be inserted. Most right handed surgeons prefer to work from the right side. Harvesting of the bone graft material is best done prior to making the neck incision(40).

Graft configurations:

Robinson Smith techinique of inter body fusion restores disc heights and by stopping excessive motions theortically allows resorbtion of posterolateral osteophytes(40). Their method of graft insertion consists of removing the pathological disc or discs at the appropriate interspace. Cartilaginous end plates and subchondral bone at the top and

bottom of the disc space to be fused are also removed. The prepared disc space is then measured and a horse shoe graft obtained from the iliac crest is inserted so that its cancellous portion is directed posteriorly. In a modification described by Bloom and Raney the graft is prepared in a similar fashion but the cortical portion is inserted directly posterior(4). This assures placement of the maximum amount of cortical bone within the disc space and allows better maintenance of disc height.

Cloward's techinique of interbody fusion consists of drilling a round hole in the region of the intervertebral disc into which is inserted a prefit dowel of bone(9). A drill is used with a guard that permits drilling of the intervertebral disc space and adjacent vertebrae to any desired depth. Drilling is continued downward until the bone at the bottom of the hole is entirely cortical in nature. This remaining cortical bone is then removed with curettes and ronguers to expose the posterior longitudinal ligament. With care direct removal of posterior and posterolateral osteophytes or a soft disc is then posssible. Once a decompression has been carried out a precut dowel of bone obtained from the iliac crest is then tapped into place. It should be slightly shorter than the depth of the drill hole. The dowel of bone is cancellous in its mid portion with

cortical bone at both ends(9).

In Bailey and Badgley's technique a trough is prepared in the anterior aspect of the vertebral body and a corticocancellous graft from the iliac crest is shaped to fit into the prepared trough(2). The other techniques include the key stone graft of Simmons(35) and subsequent modifications by Gore(15). Biomechanically White has shown that the horse shoe shaped graft of Robinson Smith resists compression forces better than the other graft configurations(45).

Complications of Anterior approaches:

There is a 3% chance of complications in anterior approaches to cervical spine. Injury to recurrent laryngeal nerve particularly with right sided approaches is the most common. The esophagus, trachea and larynx, carotid artery, jugular vein and cervical sympathetic chain are at potential risk from retraction injury and the vertebral artery may be injured if the disc or osteophyte removal is carried too far laterally. Spinal cord or nerve root injury is the most serious complication. Pseudoarthrosis, graft extrusion or resorbtion form the graft related complications. A dural tear and cerebrospinal fluid leak may also occur. Superficial or deep wound infection is uncommon with use of perioperative antibiotics (40).

Donor site problems at iliac crest are usually minimum but are common occurring in 20% of patients. These include hematoma, infection, fracture of anterior superior iliac spine, bowel injury, lateral femoral cutaneous nerve injury and persistent wound pain(40).

Comparison of various procedures:

Literature review indicates that approximately 90% of patients undergoing interbody fusion after disc excision benefit from it and 70% can be anticipated to have good or excellent result(40). It is not possible to ascertain whether or not compressive structures should be removed at the time of disc excision, since comparable results are found in those patients in which the diseased cervical segment is simply immobilized by fusion. The post operative outcome has been analysed using Odom's criteria and the same has been used in our analysis also.

Surgeons who do not advocate fusion have also claimed good results(3). In 1960 Carl Hirsch first described the partial excision of a cervical disc without accompanying fusion and all patients in his series achieved a fibrous or bony fusion(17). Murphy and Gado reported a similar operation and showed a good clinical results in 92% of cases(26). More radical excisions was reported by Robertson in 1973. He compared 53 patients who had undergone

anterior disc excision and fusion with 40 patients who had not and could find no difference in the clinical results, but felt that since a simple discectomy avoided the morbidity of bone grafting and preferred that technique(32).

A more radical surgical procedure was described by Martins in 1976. His operative technique consisted of radical discectomy with foraminotomy. At the end of procedure the dura and nerve roots are checked visually to be certain that they are free of any encroachment. 92% of patients undergoing surgery fell in good or excellent category. After comparing with another group who underwent Cloward's interbody fusion, Martins raised the question why a fusion should ever be done since there was not much difference in the outcome(24). Critical evaluation of the series available in the literature reveals that the results of the disc excision without fusion are comparable to those in which an interbody fusion is performed. Obviously the elimination of the donor site from the operative procedure decreases operative morbidity. Lunsford compared a series of 334 patients in which some had undergone fusion and some had not and stated that post operative complications were much frequent and hospital stay longer in those undergoing fusion(22).

MATERIALS AND METHODS

MATERIALS AND METHODS

From July 1986 to March 1996 all operated cases for a single level disc lesion were analysed retrospectively. The operated procedures consisted of either a Clowards or a Smith Robinson fusion in the interbody fusion group or only a simple discectomy.

Plain x-rays of the cervical spine anteroposterior, lateral and oblique views were obtained pre operatively. MRI or a myelography was done to ascertain the disc prolapse, osteophytes and cord compression.

A total number of 68 cases were operated in the study period. Follow up ranged from 6 months to 8 years with a mean of 3 years. 17 patients were lost for follow up. 47 underwent interbody fusion after micro discectomy, 31 Cloward and 16 Smith Robinson fusion. Microdiscectomy alone was done in 21. Modified Nurick's system was used to grade the preoperative status and Odom's criteria was used to grade the post operative outcome.

Modified Nurick's System:

Grade I : normal.

Grade II : works with minimal disability.

Grade III : cannot do active work, daily course possibly.

Grade IV : bed ridden, needs support.

Odom's Criteria:

Excellent: all pre operative symptoms relived, abnormal findings improved.

Good : minimal persistence of pre operative symptoms, abnormal findings unchanged or improved

Fair : benefit or relief of some pre operative symptoms or the symptoms unchanged or slightly improved.

Poor : symptoms and signs worsened or exacerbated.

During the post operative review plain X- rays of the cervical spine, lateral and oblique were obtained. Dynamic study was done in the lateral view with both flexion and extension study.

Among the 51 patients who were followed, 46 patients had post operative plain X- ray study.

The following factors were studied.

1. Whether the disc space was fused or not.
2. Whether the disc height was maintained or not.
3. The status of the intervertebral foramina at the site of surgery.
4. Whether there was any spinal deformity following discectomy.
5. The status of the graft if implanted.

The results were analysed and compared between the three groups.

DATA ANALYSIS

Table 1 : Sex distribution.

Sex	Discectomy Alone	Interbody	fusion	Total
		Cloward	Smith Robinson	
Males	16	26	11	53
Females	5	5	5	15

Table 2 - Age groups

Age Group	Discectomy Alone	Interbody fusion		Total
		Cloward	Smith Robinson	
<45 yrs	15	17	12	44
>45 yrs	6	14	4	24

Table 3 - Occupation

Occupation	Discectomy Alone	Interbody fusion		Total
		Cloward	Smith Robinson	
Head Load Workers	8	2	4	14
Others	13	29	12	54

Table 4 - Disc Levels

Level of Disc Prolapse	Discectomy Alone	Interbody fusion		Total
		Cloward	Smith Robinson	
C3 - C4	1	5	2	8
C4 - C5	8	5	3	16
C5 - C6	10	19	11	40
C6 - C7	2	2	-	4

Table 5 - Clinical Presentation

Clinical presentation	Discectomy Alone	Interbody fusion		Total
		Cloward	Smith Robinson	
Radiculopathy	1	2	3	6
Myelopathy	2	9	2	13
Myeloradiculopathy	18	20	11	49

Table 6 - Clinical Features

Clinical Features	Discectomy Alone	Interbody fusion	
		Cloward	Smith Robinson
Pain	14	23	13
Numbness	16	21	1
Posterior column sensory loss	6	15	1
Spasticity	17	27	12
Sphincter Involvement	9	12	5

Table 7 - Symptom Duration

Duration Of Symptoms	Discectomy Alone	Interbody fusion		Total
		Cloward	Smith Robinson	
< 1 Yr	8	15	7	30
1 -3 Yrs	11	11	8	30
> 3 yrs	2	5	1	8

Table 8 - Pre Operative Grading (Modified Nurick's)

Pre Op Grading	Discectomy Alone	Interbody fusion		Total
		Cloward	Smith Robinson	
Grade I	-	1	1	2
Grade II	7	8	11	26
Grade III	12	21	4	37
Grade IV	2	1	-	3

Table 9 - Post Operative Grading (Odom's)

Post Op Grading	Discectomy Alone	Interbody fusion		Total
		Cloward	Smith Robinson	
Grade I	8	21	7	36
Grade II	4	3	1	8
Grade III	3	2	1	6
Grade IV	-	-	1	1
Lost for Follow Up	6	5	6	17

Table 10 - Hospital Stay

Number of Days	Discectomy Alone	Interbody fusion		Total
		Cloward	Smith Robinson	
1 Week	12	14	7	33
2 Weeks	9	15	8	32
3 Weeks	-	1	-	1
>3 Weeks	-	1	1	2

Table 11 - Average Duration of Hospital Stay

	Discectomy Alone	Interbody fusion	
		Cloward	Smith Robinson
Number of Days	7	10	10

Table 12 - Post operative Complications

Complications	Discectomy Alone	Interbody fusion		Total
		Cloward	Smith Robinson	
Recurrent Laryngeal Nerve Paresis	1	1	1	3
Graft Displacement	‡	2	1	3
Donor Site Complications	‡	3	1	4

(‡ Not Applicable)

Table 13 - Post Operative Follow up

Post Op follow up	Discectomy Alone	Interbody fusion		Total
		Cloward	Smith Robinson	
< 1 Yr	2	-	3	5
1 - 3 Yrs	5	12	7	24
> 3 Yrs	8	14	-	22
Lost for Follow up	6	5	6	17

Table 14 - Post Operative Radiological Analysis

Feature	Discectomy alone	Interbody fusion	
		Cloward	Smith Robinson
Number	12	24	10
Disc Space			
fused	4	22(91.6%)	5(50%)
not fused	8(66.6%)	2	2
cannot assess			3
Disc height			
maintained		6	4
reduced	12(100%)	18(75%)	6(60%)
Foramina			
maintained L	1	5	2
maintained R	1	1	1
maintained B		1	1
narrowed L	1	2	1
narrowed R	2	5	2
narrowed B	8(91.6%)	15(91.6%)	3(60%)
increased L			
increased R			
increased B			3
Deformity			
ant. angulation	5(41.6%)	12(50%)	3(30%)
cannot assess	1	5	3
Graft position			
proper	NA	21(87.5%)	4(40%)
displaced	NA		3
resorbed	NA	3	3

RESULTS

RESULTS

The clinical data of the patients included in this study group has been analysed in the tables in the preceding sections. Out of 68, 82% were males and 44 of the total number of patients (68%) were below 45 yrs of age. Fourteen patients(20.5%) in the entire study group were head load workers.The commonest level of disc prolapse was at C5 - C6 level accounting for 40 patients(58.8%). Presentation with radiculopathy alone was very insignificant and bulk of the patients presented with myeloradiculopathy(72%). Spasticity was the common presenting feature in this study group(82.3%). Sixty of the 68 patients(88%) had a symptom duration upto 3 yrs. Majority of the patients(92.6%) were in either grade II or grade III Pre operatively (modified Nurick's grading) and after surgery 36 of the total 51(70.5%), who were followed up were in grade I Post operatively (Odom's criteria) and were back to work.

The analysis of the outcome is comparable in all the three study groups and patients in all the study groups have done almost equally well. Analysis of hospital stay after surgery revealed that patients who underwent interbody fusion stayed on an average of 3 more days when compared to that group who were not fused. The incidence of complications was more in the interbody fusion group and all

were graft related. They included graft site hematoma, wound gaping, wound infection, retained foreign bodies, persistent post operative pain at the donor site and osteomyelitis of the underlying bone.

Post operative radiological assesment revealed that in the discectomy alone group 66.6% were not fused, while in Cloward and Smith Robinson group 91.6% and 50% respectively had good fusion. The disc height was reduced in all the cases in no fusion group while the corresponding figures in interbody fusion were 75% and 60% respectively. This is surprising that inspite of a graft the percentage of disc height reduction is significantly high in interbody fusion group.

When the intervertebral foraminal narrowing was analyzed, 91.6% had narrowing in both no fusion and Cloward group and 60% of Smith Robinson group had narrowing. Inspite of the graft deformity was seen in 50% and 30% respectively in Cloward and Smith Robinson group and in comparision 41.6% had anterior angulation in discectomy alone group. Graft placement was proper in 87.5% in Cloward group and the incidence of graft displacement was 30% in Smith Robinson group. There was no case of graft displacement in Cloward group. This may be due to tight placement of the dowel graft in Cloward fusion.

As far as the radiological assesment is concerned there seems to be no additional benifit in doing an interbody fusion. Inspite of the narrowing of the intervertebral foramina in all the groups there is no clinical correlation and the clinical outcome does not seem to have any bearing on the radiological findings.

In the over all assessment taking into consideration all the factors only discectomy without fusion seems to be more appropriate for a single level disc lesion.

DISCUSSION

DISCUSSION

Various authors have reported good to excellent results with anterior cervical microdiscectomy. In an analysis of all the major series White Cloud has found that 74% were in excellent and good grade using the Odom's criteria(40). In the same analysis it was found that kyphotic angulation was noted in about 12% and was found to be more prevalent when more than one level was fused. But this did not seem to compromise the surgical result.

There is no question that the best surgical results can be anticipated from those patients who present with a monoradiculopathy and a duration of symptoms of less than 1 year. In our study of 47 patients who underwent interbody fusion, 28 out of 36(82.3%) who were followed up were in excellent grade according to Odom's criteria, but the post operative kyphotic deformity was significantly higher, 15 out of 34(44%).

Clinical results of those who recommend fusion and those who do not are very similar i.e., 90% of patients undergoing disc excision without fusion will derive benefit from the procedure(40). Carl Hirsch first described the technique without fusion. Twenty nine out of 35 patients(83%) undergoing the procedure had a good or excellent clinical result(17). All patients achieved a

fibrous or bony union at the area of disc excision. Subsequent series demonstrated a bony union in 70% to 100% of the cases. Boldey and Susen reported resilts similar to that of Hirsch(40).

Murphy and Gado reported 92% good clinical result with no fusion. Follow up radiographic evaluation in 20 patients showed an instance of fusion of 72% when discectomy alone was done at a single level. Even in those patients who did not have a complete fusion dynamic roentgenogram did not reveal any instability(26). All these results compare favourably with reported series of anterior cervical discectomy with interbody fusion(40).

Robertson compared 53 patients who had undergone anterior disc excision and fusion with 40 patients who had not. He could find no difference in the clinical results, but felt that since a simple discectomy avoided the morbidity of bone grafting, he preferred this technique(32). Martins compared patients undergoing fusion and to those with no fusion and found that results were similar in both groups with 92% having good or excellent results. He raised the question why a fusion should ever be done(24).

In comparision to other series, in our study group of 21 patients who underwent only discectomy 12 out of 15 who were followed up were in excellent and good grade making up

80%. Post operative radiological analysis showed that 66.6% did not have good fusion. There was intervertebral foraminal narrowing in 92% and anterior angulation in 42% and this almost similar to that seen in interbody fusion group.

CONCLUSIONS

CONCLUSIONS

The following conclussions can be drawn from this study.

1. There is no significant difference in the clinical and radiological outcome with and without interbody fusion.
2. Since the morbidity due to bone graft is avoided and the hospital stay is reduced microdiscectomy without fusion can be safely adovacated for a single level disc lesion.
3. The radiological picture of intervertebral narrowing and minimal kyphotic deformity does not seem to have any clinical correlation.
4. The interposition of graft does not seem to be the solution to prevent post operative kyphotic deformity and intervertebral narrowing.
5. Since there is no correlation between the clinical and radiological outcome with regard to kyphotic deformity the need for the post operative radiological study does not seem to exist.

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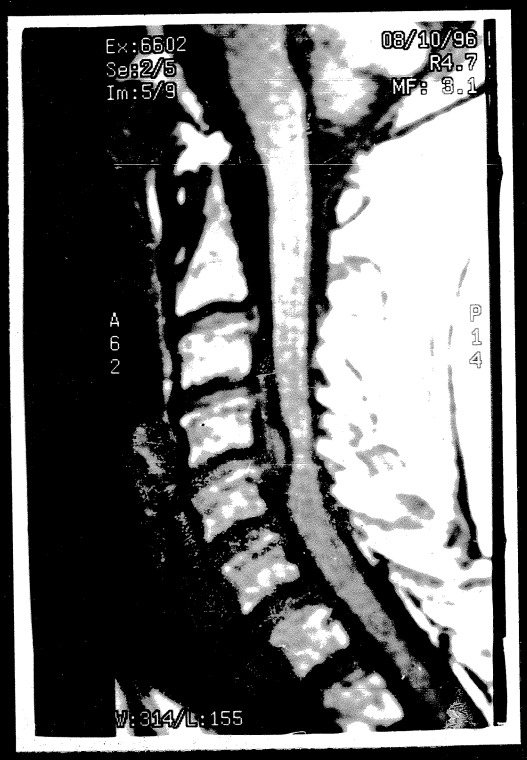
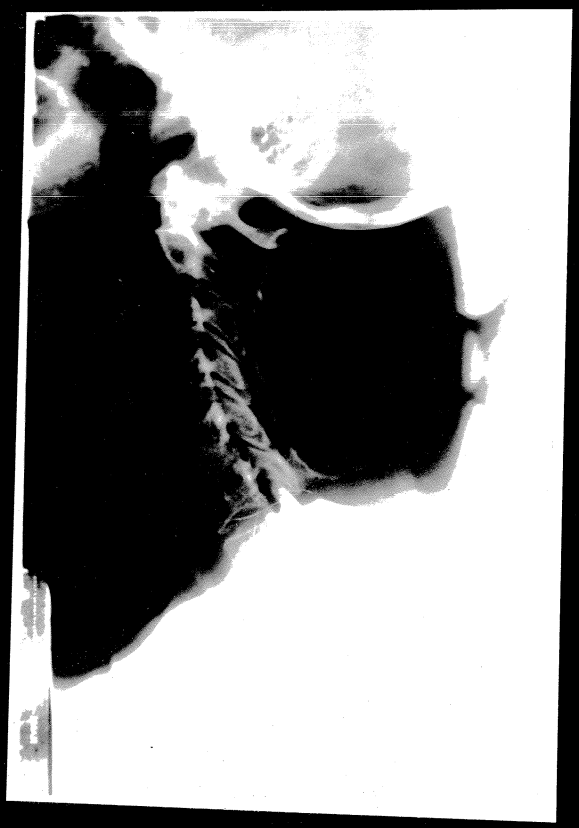
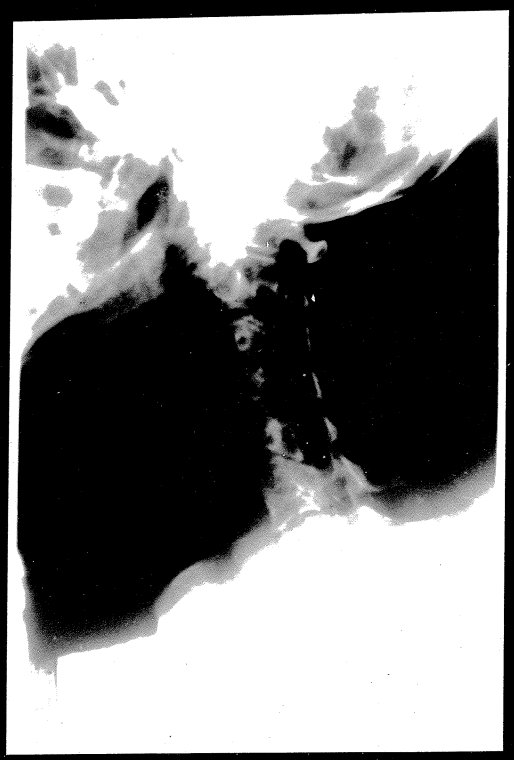


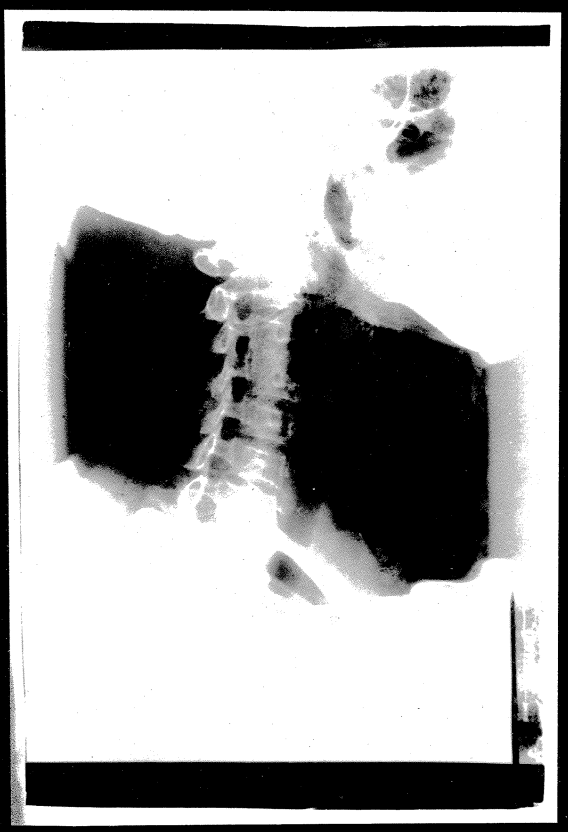
MRI sagittal T1 and T2 showing extruded disc at C4-C5 with cord compression.

MRI axial of the same patient showing central cord compression.





Post op Smith Robinson fusion lateral and oblique views showing good fusion.



Post op Cloward fusion lateral and oblique views showing good fusion.

Post op Discectomy alone
lateral and oblique views
showing disc space narrowing.