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Artículo:

Percutaneous cervical arthrodesis. Original technique

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Original article

Percutaneous cervical arthrodesis. Original technique

Braulio Hernández Carbajal*

General Hospital of Mexico

SUMMARY. The instruments used are reported and an original percutaneous cervical arthrodesis is described. This arthrodesis is performed under local anesthesia and sedation on an ambulatory basis. It may be performed in the operating room or the X-ray room. The history after two years of the first seven patients, four females and three males, aged 36 to 68 years, who underwent this procedure diagnosed with relapsing single or multiple disc herniation is reported. Herniation turned into percutaneous nucleotomy occupying less than 25% of the vertebral canal, disc herniation with spine instability or discarthrosis. Patients with cord compression, non reducible spondylolisthesis or progressive neuropathy were excluded. The result was good in six patients (85.7%) with pain disappearing, neurological recovery and reintegration to their normal activities after 2 weeks. One patient did poorly because of graft resorption forcing to a second open surgery. Few problems occurred including pharyngitis and dysphagia occurring in three patients during the immediate postoperative period, inherent to the tracheal, pharyngeal, and esophageal manipulation. Total recuperation time was no more than three weeks. We recommend this technique in patients diagnosed with single cervical disc herniation or accompanied by discarthrosis and/or reducible instability with no more than two levels compromised. However we have certain reservations about the C2-C3 level.

Key words: cervical spine, arthrodesis, percutaneous nucleotomy, treatment.

RESUMEN. Se da a conocer el instrumental y se describe una original técnica de artrodesis cervical percutánea (ACP) bajo anestesia local y sedación; el procedimiento es ambulatorio y puede realizarse en quirófano o sala de rayos X. Se reporta la evolución a dos años de los primeros siete pacientes sometidos a este procedimiento, cuatro del sexo femenino y tres del masculino, en edades entre 36 y 68 años, por diagnóstico de hernia de disco única o múltiple recidivante a nucleotomía percutánea que ocupara menos del 25% del canal vertebral, hernia de disco con inestabilidad de columna o discartrosis; se excluyó a los pacientes con compresión medular, espondilolistesis no reductible o neuropatía progresiva. El resultado fue bueno en seis pacientes (85.7%), con desaparición del dolor, recuperación neurológica y reintegración a sus actividades al cabo de 2 semanas y malo en uno debido a reabsorción del injerto, lo que obligó a reintervenir en forma abierta. Los problemas fueron pocos y consistieron en faringitis y disfagia que se presentó en tres pacientes durante el postoperatorio inmediato y fueron inherentes a la manipulación de tráquea, faringe y esófago, con total recuperación en máximo tres semanas. Recomendamos esta técnica en pacientes con diagnóstico de hernia de disco cervical solitaria o acompañada de discartrosis y/o inestabilidad reductible, con compromiso de máximo dos niveles, teniendo nuestras reservas en el nivel C2-C3.

Palabras clave: columna cervical, artrodesis, nucleotomía percutánea, tratamiento.

Introduction

Nucleotomy and arthrodesis approached anteriorly by using a Cloward type round graft[1] has been the classical treatment for disc disease of the cervical spine with instability problems and neurological compromise. At present, metal plates and screws are used to stabilize the segment and as-

* Coordinator of the Minimally Invasive Spine Surgery Clinic, Orthopedics Service of the General Hospital of Mexico.

Mailing address:
Braulio Hernández Carbajal. Tehuantepec 86-302. Col. Roma Sur, CP 06760. México, D. F. Telephone: 5564 7760, 5564 0423
E-mail: hecb@prodigy.net.mx

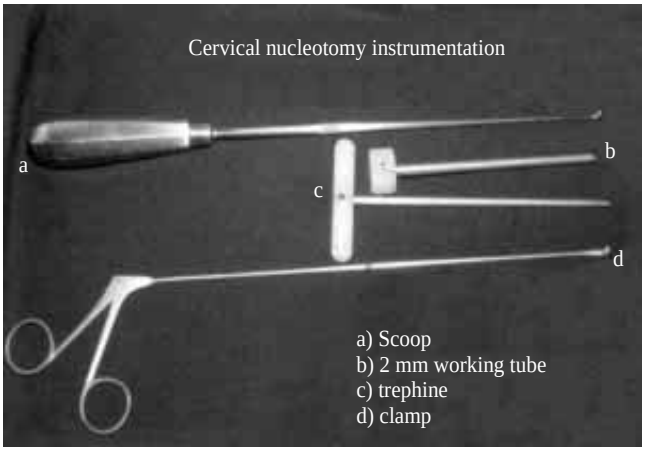

Figure 1.

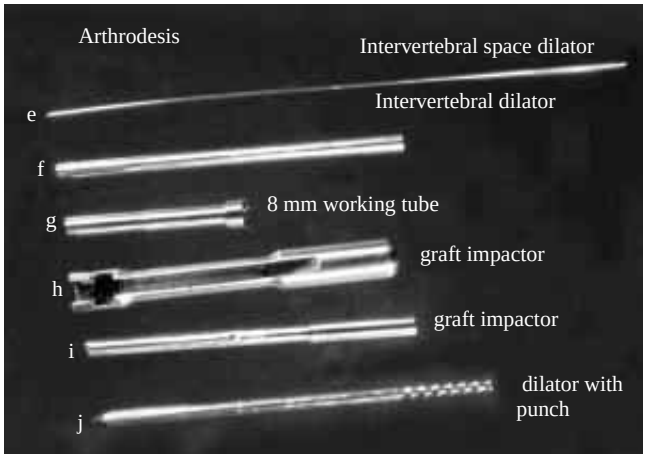

Figure 1a.

sure the integrity of the bone graft.[3] Good to excellent results have been reported with this technique. However, the system is not exempted from complications ranging from laryngitis to irreversible neurological injury. Immediate postoperative pharyngitis, late pharyngitis or pharyngitis due to irritation caused by the plate and screws, laryngeal nerve injury, and vascular lesions have also been reported.

Since Hijikata,[4,5] who in 1975 described the posterolateral approach with local anesthesia and a 1 cm incision to remove the lumbar nucleus pulposus by using clamps and scoops, several authors have published their experience with percutaneous nucleotomy at the lumbar and/or cervical level with good results ranging from 70% to 78% for cervical cases, their only complication being a cervical hematoma.[14,15,18-20]

Since 1991, several authors have described the percutaneous lumbar arthrodesis by different methods (manually, endoscopically, with external fixation, etc.).[6-12,16,17] In 1995, during the First Percutaneous Spine Surgery Course at the General Hospital of Mexico, Adrian Monteiro from Belgium presented his manual percutaneous arthrodesis technique for the lumbar spine through an 8 mm working tube. Through this tube, Monteiro performed a curettage procedure of the intervetebral space and placed an iliac crest bone graft.[13] Based on the experience and good results derived with this technique, we decided to implement percutaneous cervical arthrodesis in 1998 performed under local anesthesia. To this end the author designed the instruments to make the procedure easier and eventually perform it.

The purpose of this paper is to report the instruments and describe this original technique. We have not found any worldwide communication similar to the technique and therefore we decided to report how the first 7 patients who underwent this procedure have done.

Material and methods

In the first stage the instruments were designed and tested in cadavers *(Figure 1)*. Two, four, six, and eight mm in diameter, cannular dilators were snuggly introduced into the intervertebral space. The disc was scraped and removed with scoops of several sizes and angles. And a bone bed for the graft was prepared. Bone grafts of different sizes were tested until the most appropriate was found. It was an 8 x 10 mm, graft of cylindrical shape. When we decided the instruments were appropriate, we proceeded to do the clinical testing.

In June 1998, we started performing the percutaneous cervical arthrodesis. This report describes how the first seven patients did over a period of two years. Patients had been treated with this technique *(Table 1)* because of diagnosed relapsing disc herniation turning into percutaneous nucleotomy with less than 25% of the vertebral canal occupied, disc herniation with spine instability or discarthrosis. Patients with spinal cord compression, non reducible spondylolisthesis and progressive neuropathy were excluded. The age at the time of surgery ranged between 36 and 68 years with an average of 47 years. There were four female patients and three male patients. Before the surgical procedure, all patients underwent simple cervical X-rays, MRI and/or CT scan on neuroconduction of chest limbs occurring in one, two or three levels. Patients wore Philadelphia type collars until the bone graft was seen to have been completely consolidated.

Table 1.

Patient	Diagnosis	Age	Gender	Level of arthrodesis
VVG	DH	45	F	4-5/5-6
MFC	DH + SL	46	M	4-5/5-6
CAB	DH + SL	38	F	4-5/5-6
RRE	DH + DA	68	M	5-6
ILM	DH	50	F	5-6
DPP	DH	46	F	5-6
ALC	DH + SL	36	M	2-3

Disc herniation (DH), Spondylolisthesis (SL), Discarthrosis (DA)

Table 2.

	Outcome	
	Good	Poor
Clinical findings		
Pain	Disappears	Persists
Mobility	Complete	Limited and painful
Activity	Recuperated	Functional limitation
Imaging findings		
Graft integration	Yes	No
Intervertebral space	Maintained	Decreased
Dynamic study	Stable	Unstable

The presence of any poor criterion implies that outcome

Follow up included a monthly clinical and X-ray assessment until consolidation and a dynamic X-ray quarterly assessment. Variables studied were pain, neurological information, number of arthrodesed levels, graft consolidation, trans and/or postoperative complications, duration of surgery, and hospital costs. Secondary variables involved age at the time of surgery and gender of patients.

The results were classified as good or poor considering general, clinical and X-ray criteria for spine arthrodesis (*Table 2*).

Instruments. To take the bone graft we used an 8 mm diameter cylindrical guide with a punch to impact the iliac ala, an 8 mm trephine and a Hodson handle to turn the trephine and remove the graft *(Figure 1)*. For the nucleotomy and arthrodesis we used a 1 x 150 mm guide needle, 1, 2, 3, and 4 mm dissectors, 2, 4, 6, and 8 mm cannular dilators, 2, 4, 6, and 8 mm working tubes (jackets), 2, 4, and 6 mm trephines, a 7 mm cannular drill, 4, 6, and 8 mm scoops, 4 and 6 mm clamps to remove the disc, and a graft impactor with tip support *(Figure 1)*.

Graft harvesting. In the middle of the iliac ala, and one centimeter below the crest, a 2 cm squared area is infiltrated with 2% xylocaine combined with epinephrine. A 20 mm incision is made and the tip guide is impacted on the iliac ala. The 8 mm working tube is introduced and through this tube, the trephine with handle is introduced and turned to get an 8 x 18 mm cortical graft. Finally, the skin is sutured with two stitches *(Figure 2)*.

Nucleotomy and arthrodesis. The approach technique is based on Theron´s descriptions[20] and the instruments for arthrodesis are designed by the author taking Monteiros' instrumentation as a basis.[13] The patient is under IV sedation, placed on a supine decubitus position and traction and extension is put on the neck with a 2 kg cervical sling. With the help of a fluoroscope with an anteroposterior projection, the problem cervical vertebra is located and its center is marked with a metal plate. On a lateral projection, and on the side opposite to the pain irradiation, the guide needle path is outlined with a marker. The skin and subcutaneous cell tissue are infiltrated with 2% lidocaine combined

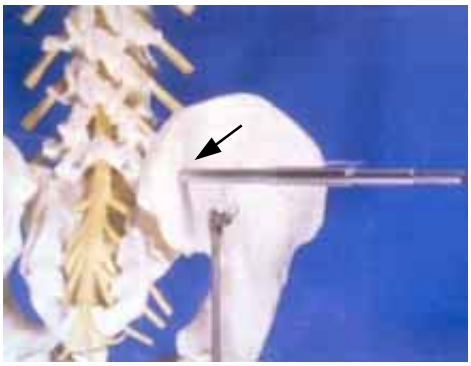

Figure 2a.

Figure 2b.

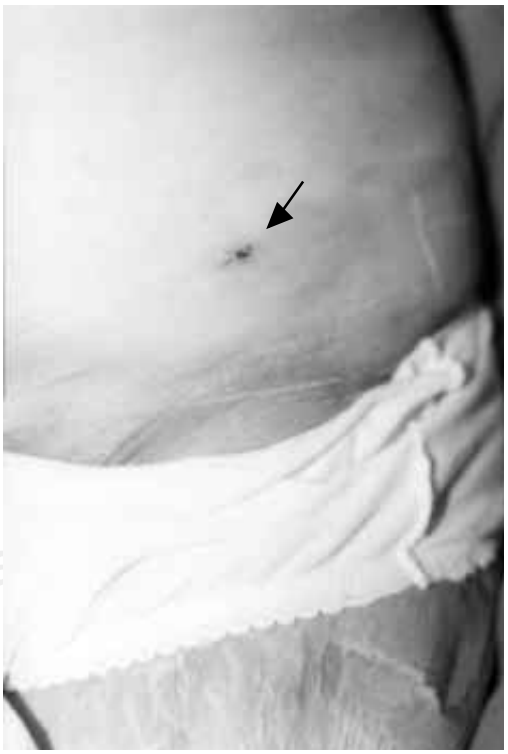

Figure 2c.

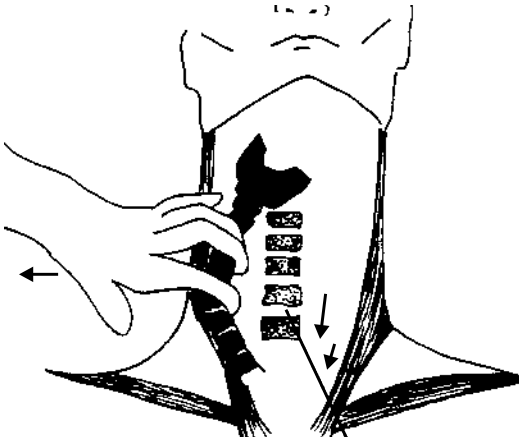

Figure 3a. With the right hand, the assistant pushes the esophagus, trachea, thyroid pack. A guide is introduced in the problem space at a 20° inclination against the midline and 20° towards the cephalic portion. The arrow shows the pack displacement direction. Dual arrows show the guide pin.

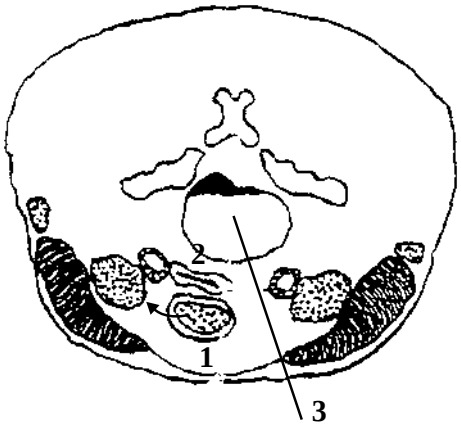

Figure 3b. In 1 and 2, the trachea, esophagus, thyroid bundle is moved from the midline. In 3, the guide needle is placed in the middle of the disc, at a left 20° inclination from the midline and 20° from bottom to top.

with epinephrine. The trachea, esophagus, and thyroid are pushed to the opposite side *(Figure 3a)*. With fluoroscopic control, the guide needle is introduced at a lateral and cephalic 20° inclination to place it in the center of the problem space *(Figure 3b)*. A 10 mm transverse incision is made on the skin and the 1 to 4 mm dissectors are introduced. After that, the dilator and 4 mm working tube are introduced and through the working tube the bloody bed is prepared with the trephine. The bloody bed reaches 2 mm from the opposite border of the fibrous ring and with the help of the disc clamp and scoops, the intervetebral disc is removed. This is repeated with the 6 and 8 mm instruments by changing the trephine for the 7 mm drill in the last step. The graft length is measured and impacted impregnated with a dye for X-ray control *(Figure 4)*. The skin is sutured and immobilized with a Philadelphia type collar. The patient is discharged after recovering from the anesthesia.

All patients were informed about the experimental character of the procedure for them to give their written consent to it.

Results

The outcome was good for six cases (85.%) and poor for one due to graft resorption, pain persistence and paresthesia. In all six cases with a good outcome, pain disappeared completely and patients have remained asymptomatic two years after the procedure. In terms of neurological information, four patients suffered from paresthesia and 2 from

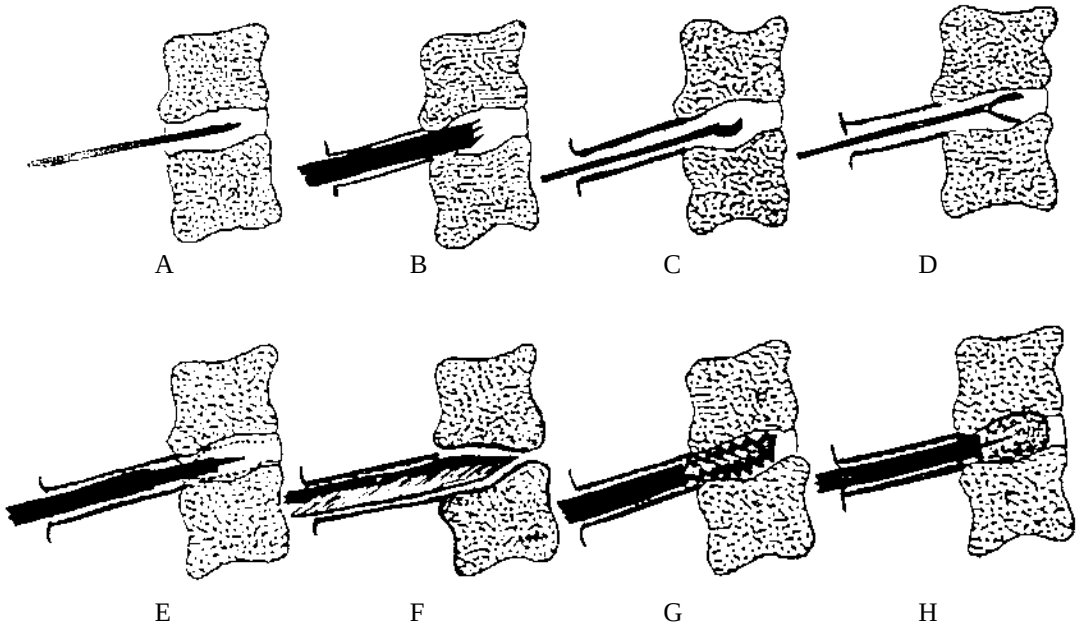

Figure 4. Diskectomy. **A.** It is placed at the center of the space at a 20° inclination in a lateral and cephalic direction. **B.** 4 mm working channel and trephine sectioning the fibrous annulus. **C.** Curette removing the nucleus pulposus. **D.** Disc forceps removing the nucleus. Arthrodesis. **E.** Tubes are inserted until the 8 mm tube can fit. **F.** The awl is advanced through the tube to open up the space. **G.** Cannulated drill bit to carve a 7 mm-diameter bed. **H.** Impacted graft up to 2 mm from the posterior vertebral border. Impactor with awl to fix the graft.

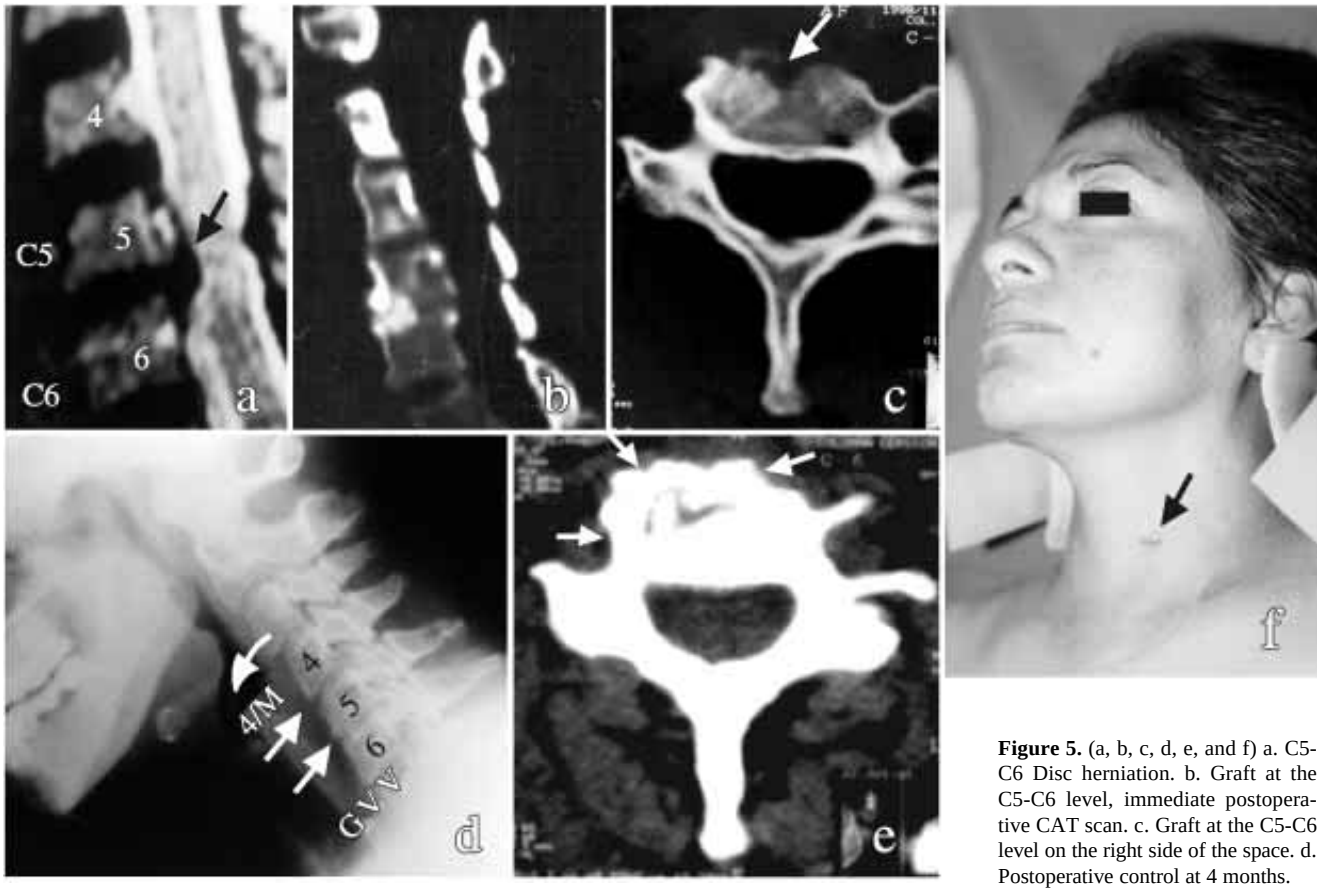

Figure 5. (a, b, c, d, e, and f) a. C5-C6 Disc herniation. b. Graft at the C5-C6 level, immediate postoperative CAT scan. c. Graft at the C5-C6 level on the right side of the space. d. Postoperative control at 4 months.

paresis. Total recovery was seen in all except the patient having a poor outcome where paresis persisted at the C5 level. Consolidation was achieved in six patients between 6 and 10 months after the surgery. All of them have maintained the space height and stability on dynamic testing. All six patients went back to their normal activities within 2 weeks *(Figure 5)*.

Pharyngitis and dysphagia was seen in three patients for no more than three weeks. The most intense occurred in the patient operated at the C2-C3 level who suffered from severe dysphagia, even for liquids so he was parenterally fed for one week. The patient suffering from graft migration required a second percutaneous surgery with good outcome. The arthrodesis in the patient undergoing surgery for three levels failed. It was necessary to operate again with open surgery due to pain persistence and paresthesia.

The average duration time of surgery was 45 minutes per arthrodesed level. The hospital cost was 80% less expensive than surgery with plate and screws.

Discussion

Cervicobrachial pain caused by herniated discs, discarthrosis or instability responds satisfactorily to orthopedic and physiatric treatment in 80% of cases. The remainder cases require surgical treatment. Cloward advocated the combination of discectomy and arthrodesis as a good solution to the problem because the graft opens the space, in addition to stabilizing the spine.[1]

In reviewing the world literature we found several authors performing percutaneous arthrodesis at the lumbar level.[8-11,13-17]. However we found no report at the cervical spine level.

The approach is simple and safe. By pushing the trachea, esophagus and thyroid, a space is opened through which it is possible to access the spine with no risk of injuring noble structures. With the help of fluoroscopy, it is perfectly possible to locate the space where work will be done.[10] Space C2-C3 was the only space difficult to access. At this level, the trachea is quite broad and requires significant moving. This resulted in severe dysphagia for the only patient undergoing this approach. He was unable to swallow even liquids so it was necessary to feed him parenterally for one week.

In arthrodesing one or two levels no problems occurred in terms of graft consolidation. The three level case, however, failed due to graft resorption. The need to protect the arthrodesis and fixate it with a plate is controversial. In a prospective study Connolly et al. compared 43 patients who underwent cervical fusion with or without plate. There were no differences found when operating on one level. However, the pseudoarthrosis and graft collapse rates increased when using a plate in multiple fusions.[2] This opinion is shared by several

authors and, in turn, debated by others. Generally, however, it is accepted that for cases involving one level only, arthrodesis needs no protection with a plate which is only necessary when involving more than two levels. Drew's study in Canada about the surgical preferences of anterior cervical discectomy showed that although 90.5% of surgeons (spine surgeons, orthopedic surgeons, neurosurgeons) indicate arthrodesis, only 36.2% uses a plate in cases of one level only.[3]

The time for the graft to consolidate depended on the number of levels. Patients with two levels arthrodesed required more time to achieve it than those with only one level treated. This is consistent with the reports in the literature.

Functional recovery occurred rapidly. Patients were able to gradually go back to their normal daily activities beginning the third week and have remained active with no limitations over two years after the surgery.

Problems with this technique were just a few with no repercussions except for the patient who suffered graft resorption. These problems occurred during the immediate postoperative period and most were inherent to the tracheal, pharyngeal and esophageal manipulation with a maximum total time to recovery of three weeks. For the patient with graft displacement, it was attributed to inexperience with the procedure and it became a part of the learning curve. The problem was solved by following the same procedure a second time.

Although the time required to perform this procedure did no vary substantially from the time used with the open technique, the hospital costs did decrease by as much as 80% because this is an outpatient procedure. The outpatient management was no problem and no major complications occurred. Only one patient had to be readmitted for parenteral feeding due to severe pharyngitis.

We found no differences in results when comparing the age or gender of patients.

We recommend this technique for patients diagnosed with single herniated disc accompanied by discarthrosis and/or reducible instability with maximum compromise of two cervical spine levels, although we have some reservations about the C2-C3 level.

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