Arq Neuropsiquiatr 2004;62(3-B):815-820

TLIF - TRANSFORAMINAL LUMBAR INTERBODY FUSION

Nicandro Figueiredo[1], Johnny Wesley G. Martins[2], Alfredo A. Arruda[1], Alexandre R. Serra[1], Marco Antônio A. Figueiredo[3], Rodrigo C. Diniz[4], Alessandro A. Cavicchioli[5]

ABSTRACT - Transforaminal lumbar interbody fusion (TLIF) is a relatively new technique of lumbar arthrodesis via posterior transforaminal approach to the disc, indicated mainly in cases of degenerative disc disease, low grade spondylolisthesis and reoperation for disc herniation, specially when there is indication for interbody fusion and posterior decompression. The main advantage of TLIF is that it allows the complete removal of the intervertebral disc through the vertebral foramen, decompression of the spinal canal and vertebral foramen with minimum risk of neural lesion, due to the access being lateral to the nerve roots. In this study, we describe the first 24 cases of TLIF that we have done, wich shows to be very safe and efficient in our serie, with an relief of pain in 83.3% of patients, great improvements in the life quality in 75% of cases and satisfaction with the surgery in 79.1% of patients.

KEY WORDS: transforaminal lumbar interbody fusion, lumbar disc disease, transforaminal access.

TLIF - artrodese intersomática lombar transforaminal

RESUMO - Artrodese lombar intersomática transforaminal (TLIF) é uma técnica relativamente nova de artrodese lombar intersomática via transforaminal posterior, indicada principalmente nos casos de doença discal degenerativa, espondilolistese (grau I e II) e reoperação para hérnia discal, especialmente quando existe indicação para fusão intersomática e descompressão posterior. A maior vantagem do TLIF é que ele permite remoção completa do disco através do forame, descompressão do canal e neuroforame, com mínimo risco de lesão neural, uma vez que o acesso é lateral aos nervos. Em nosso estudo, descrevemos os primeiros 24 casos de TLIF que realizamos, que se mostrou como cirurgia segura e eficiente em nossa série, com alívio da dor em 83,3% dos pacientes, melhora na qualidade de vida em 75% dos casos e satisfação com a cirurgia em 79,1% dos pacientes.

PALAVRAS-CHAVE: artrodese lombar intersomática trans-foraminal, doença discal lombar, acesso transforaminal.

Lumbar pain has tormented man for thousands of years. There are descriptions of lumbar and ciatic pain in Bible and writings of Hipocrates. About 70 to 80% of the people have significant lumbar pain at some time in their lives[1]. In spite of the importance of lumbar pain for many years, only more recently has the pathophysiology been well understood. In 1934, Mixter and Barr demonstrated with propriety the ruptures of the discs and the association with lumbar and leg pain, from compression of the herniated discs above the neural structures[2]. The classic work of Crock and colleagues was the pioneer in identifiying lumbar pain at the disc origin not due to mechanical compression[3]. Since then innumerable studies have contributed to better comprehension of disc degeneration as the source of lumbar pain in many patients. Its pathophysiology is probably due to degeneration, thus causing alteration of properties of the discs. These alterations result in biochemical and structural irrtation of the adjacent nerve endings, as well as of new nerve ingrowth into the interior portion of the disc, thus provoking lumbar and referred leg pain[4].

Among the most common causes of chronic lumbar pain are the dicogenic pain syndrome, that could be caused by disc herniation, segmental instability, spinal stenosis, internal disc disease (IDD) and degenerative disc disease (DDD). Internal disc dis-

[1]Professor of Neurosurgery, University of Cuiabá, Cuiabá MT, Brazil; [2]Professor of Neurosurgery, Catholic University of Brasília, Brasília DF, Brazil; [3]Neurosurgeon, Instituto Neurológico e da Coluna Vertebral, Cuiabá MT, Brazil; [4]Neurosurgeon, Base Hospital of Brasília, Brasília DF, Brazil; [5]Medical-doctor, Instituto Neurológico e da Coluna Vertebral, Cuiabá MT, Brazil.

Received 24 November 2003, received in final form 31 March 2004. Accepted 21 May 2004.

Dr. Nicandro Figueiredo - Instituto Neurologico e da Coluna Vertebral INEC - Rua Thogo Pereira 255 / 2nd. floor - 78020-670 Cuiabá MT - Brasil. E-mail: nicandro2@yahoo.com

ease is similar to DDD, except that in IDD the disc is not so degenerated, so the disc high is still preserved, as well as there is no bone sclerosis adjacent.

The majority of patients with lumbar pain caused by IDD or DDD obtain significant relief of their symptons only with adequate clinical treatment which consists of moderate rest, physical therapy and medicine such as antiinflamatories, analgesics, muscular relaxants and antidepressants[5].

There are several types of lumbar arthrodesis and among the most used are the following: posterior lumbar fusion (PLF), posterior lumbar interbody fusion (PLIF), anterior lumbar interbody fusion (ALIF), circumferencial 360 fusion (front and back) and more recently, the transforaminal lumbar interbody fusion (TLIF). Based on pathophysiologycal knowledge of the disc lesion and the biomechanics of the spine, we can infer that the best way to surgically treat disc degeneration must deal with two fundamental aspects to eliminate the focus of the pain of the damaged disc and reduce movement of the afected segment. This can be accomplished by total removal of the disc and interbody fusion, wich is the most efficient way to perform an immobilization between two vertebra[6,7]. The PLF with pedicle screws is relatively simple, safe and permits good posterior decompression. However, it doesnot remove the disc nor immobilize the segment very efficiently[6,8,9].

The ALIF permits excellent removal of the disc and segmental immobilization, doesnot jeopardize the posterior paravertebral muscles or spinal nerves, and it doesnot cause posterior instability. However, there is the risk of lesion of the pre-sacral plexus (causing retrograde ejaculation in man), large blood vessels and principally it doesnot achieve good posterior decompression (canal and vertebral foramen) wich is frequently needed in these cases of degenerative disease[5,7,10]. The ALIF also can be utilized in cases where the PLF has failed[11]. Recently, a variant of PLIF called TLIF, developed by Harms, uses a posterior approach to the spine, but accesses the disc space *via* a path that runs through the far lateral portion of the vertebral foramen, allowing the complete removal of the disc and placement of an interbody support transforaminally. This technique reduces the risk of neural lesion while at the same time it permits posterior decompression and interbody fusion[12-14]. The main indications of this surgery are for DDD, spondylolisthesis (low grade), spinal stenosis and some cases of recurrent disc herniation, when is needed an solid interbody and posterolateral fusion, with an posterior decompression [13].

In this study, we made preliminary analysis of the first 24 consecutive cases of TLIF we have done in two different institutions in Brazil, with emphazis in its indications, details of the surgical technique and our initial impression of this new surgery.

METHOD

Patients

In April 2001, we began to perform the TLIF in two institutions: the Jardim Cuiaba Hospital, in Cuiaba - MT, and Santa Lucia Hospital, in Brasilia - DF. The first 24 cases of TLIF were studied and discussed in this article.

There were 17 female and 7 male patients. Their age varied from 24 to 62 years old; mean age was 42.16 years old.

Surgical technique

The TLIF arose as an improvement of PLIF, accessesing the intervertebral disc through the far lateral portion of the vertebral foramen, by avoiding access to the disc through the vertebral canal, close to the dural sac and nerves. A description of the surgical technique is as follows[13]:

Patient under general anesthesia in prone position, maintaining the lumbar lordosis. Posterior midline incision extending slightly beyond the levels to be approached, followed by subperiostal dissection of the muscles until complete exposure and decortication of the transverse processes with a high speed drill. Posterior decompression of the canal and vertebral foramen, as far as necessary.

Unilateral resection of the inferior articular facet of the superior vertebra and the superior articular facet of the inferior vertebra, exposing unilaterally the intervertebral vertebral foramen. Exposition of the posterolateral portion of the ipsilateral disc space in the topography of the vertebral foramen. Coagulation (with bipolar) of the small epidural vessels, visualization and protection of the dura medially.

Posterolateral fixation with pedicle screw; removal of the disc through the vertebral foramen, and also of the end plates. Distraction of the involved segment using an rod over the screws on the opposite side, completing the removal of the cartilagenous material inside the disc space. Take cancelous bone from the iliac bone for graft; placement of bone graft in anterior part of the disc space transforaminally, and then, introduction of two titaniun mesh cages filled with cancelous bone two.

Deposition of bone graft for posterolateral fusion between the transverse processes; fixation of the second rod and compression with the screws. Leave one drain for the iliac and another inside the main sugical region. Inspection of the surgical bed, hemostasis, closing by layers and bandage.

Post-operation

The patients were advised to begin to walk one day

Table 1. Patients submitted to TLIF.

Case	yager	Sex	Spine disease	Level	Previous spine surgery	Smoker	Postoperatory (months)	Pain relief	Return to work	Physical restriction	Pain after surgery
1	59	F	Spondylolisthesis + spinal stenosis	L3/L4	No	No	20	Good	Yes	Mild	Great improvement
2	62	F	Disc herniation	L5/L6	No	Yes	25	Good	Light work	Mild	Great improvement
3	36	M	DDD	L5/S1	No	Yes	24	Good	Yes	Mild	Great improvement
4	29	F	Disc herniation + DDD	L5/S1	No	Yes	21	Good	No	Moderate	Great improvement
5	44	F	Disc herniation + DDD	L4/L5	No	No	28	Good	Light work	Moderate	Great improvement
6	37	F	DDD	L4/L5 + L5/S1	No	Yes	28	Poor	Yes	Moderate	Worsening
7	56	F	DDD	L5/S1	No	No	27	Good	Yes	Moderate	Great improvement
8	34	F	DDD	L5/S1	Yes	Yes	26	Good	Yes	Moderate	Great improvement
9	57	F	DDD	L4/L5	No	No	26	Good	Light work	Mild	Great improvement
10	28	M	DDD + Spondylolisthesis	L5/S1	No	No	23	Good	Light work	Mild	Great improvement
11	38	F	DDD	L5/S1	No	No	26	Good	Yes	Mild	Great improvement
12	35	F	Iatrogenic instability laminectomia	L4/L5	Yes	No	28	Good	Light work	Moderate	Great improvement
13	41	F	Disc herniation + Iatrogenic instability	L4/L5	Yes	No	26	Good	No	Moderate	Great improvement
14	39	M	Iatrogenic instability + spinal stenosis	L5/S1	Yes	No	27	Good	Yes	Mild	Great improvement
15	43	F	Disc herniation	L4/L5	Yes	Yes	18	Good	No	Severe	Great improvement
16	24	F	Spondylolisthesis	L5/S1	No	No	22	Good	Yes	Mild	Great improvement
17	49	M	Spondylolisthesis	L4/L5	Yes	Yes	26	Poor	No	Severe	Worsening
18	51	F	Iatrogenic instability	L4/L5 + L5/S1	No	No	28	Poor	No	Moderate	Mild improvement
19	51	M	Iatrogenic instability	L4/L5	Yes	No	26	Good	Yes	Moderate	Great improvement
20	50	M	Spondylolisthesis	L4/L5	No	No	23	Good	Yes	Moderate	Great improvement
21	25	F	DDD*	L5/S1	No	No	25	Poor	No	Moderate	Mild improvement
22	36	M	DDD	L5/S1	No	Yes	28	Good	No	Severe	Great improvement
23	56	F	DDD	L4/L5	No	No	21	Good	No	Severe	Great improvement
24	32	F	Disc herniation	L4/L5	No	No	24	Good	No	Moderate	Worsening

*DDD, degenerative disc disease.

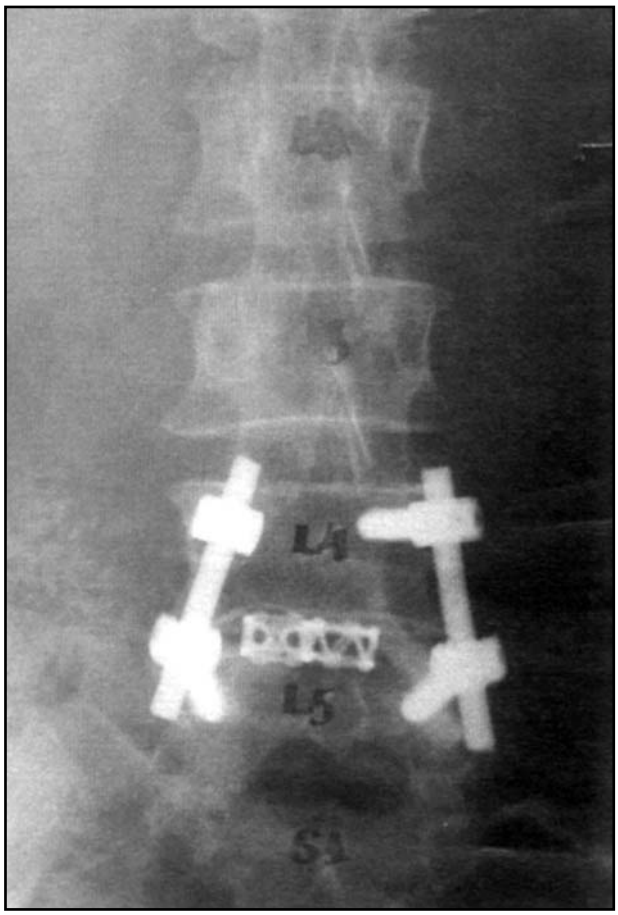

Fig 1. X-ray (AP). TLIF (L4-5).

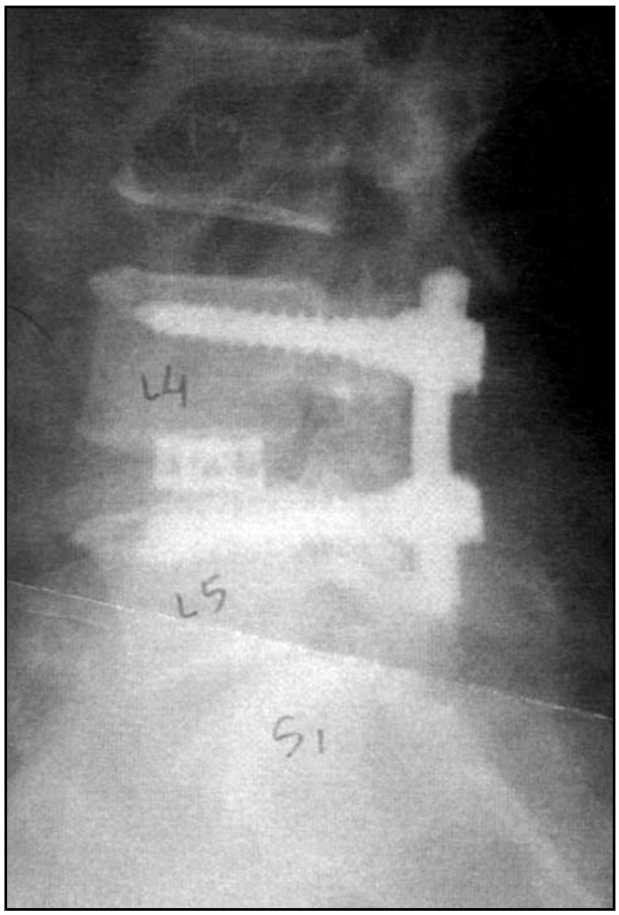

Fig 2. X-ray (P). TLIF (L4-5).

after the surgery, wearing vest or elastic belt for comfort for 2 months, and were usually discharged on the second or third day after surgery. We prescribed analgesic and muscle relaxant, and we avoided the use of antiinflamatories and tobacco.

The patients were routinelly evaluated by the surgeons at intervals of 1, 3, 6 and 12 months after surgery, and by the interviewers (by phone) for at least 18 months.

RESULTS

In the period from April to November 2001, 24 patients were submitted to TLIF in these two institutions and included in this study (Table 1). The main indications of TLIF were the following: DDD, spondylolisthesis, recurrent disc herniation, and segmental iatrogenic instability.

The fusion was done in only one level in 22 patients and in 2 levels in 2 patients. We used pedicle screws, rods and mesh cages, with the appropriate instrument set (Sofamor-Danek and MDT brands) (Figs 1 and 2).

We obtained good or excellent relief of pain in 83.3% (N = 20) of the patients, and poor relief in 16.7% (N = 4). There was a great improvement in life quality in 75% (N = 18) of the patients, no relief in 12.5% (N = 3), moderate worsening in approximately 4.1% (N = 1), and significant worsening in 8.3% (N = 2).

In relation to satisfaction with the surgery, 79.1% of the patients (N = 19) felt very or moderately satisfied, 16.7% (N = 4) were satisfied and 4.1% (N = 1) were unsatisfied (Table 2).

Surgical complications were uncommon in our series. There was partial descence of suture in 2 cases, and they were treated with bandages and rest. Also, there was significant posterior dislocation of the second cage inserted in 2 cases, requiring reoperation and removal of the dislocated cage in both cases, with good result.

In another case, there was 3 mm posterior dislocation of one cage, which caused chronic neurogenic left leg pain, without motor deficit. She improved temporarily with conservative treatment. After about two years, she was submitted to a revision surgery, when she had the dislocated cage removed and new rods reinserted with bone graft, because she had pseudoarthosis. She experienced pain reliefe, but still has some leg numbness.

Table 2. Surgical results.

Evaluation	Frequency	%	p
Pain improvement			
Good	20	83.3	0.01> p >0.001
Poor	4	16.7	
Levels			
1	22	91.6	
2	2	8.4	
Surgical indications			
DDD	9	37.5	
Spondylolisthesis (grade I or II)	5	20.8	
Recurrent disc herniation	5	20.8	
Iatrogenic instability	5	20.8	
Quality of life			
Improvement	18	75	0.05> p >0.02
No improvement	3	12.5	
Moderate worsening	1	4.1	
Severe worsening	2	8.3	
Lumbar or leg pain after surgery			
Great improvement	19	79.1	0.01> p >0.001
Modest improvement	2	8.3	
Moderate worsening	1	4.1	
Severe worsening	2	8.3	
Satisfaction with the spine after surgery			
Great or moderate satisfaction	19	79.1	0.01> p >0.001
No change	4	16.7	
Dissatisfaction	1	4.1	

*DDD, degenerative disc disease.

DISCUSSION

There are several different techniques of lumbar circumferencial fusion Among those, ALIF, PLIF, and more recently TLIF. In these techniques, ALIF is done through anterior approach, while PLIF and TLIF are done posteriorly. The difference is that in PLIF the access to the disc is through the canal, and in TLIF is through the inferior portion of the neurovertebral foramen.

Lowe and Tahermia[15] evaluated the cases of 40 patients operated by the TLIF technique. Twenty-three patients had DDD, 13 had spondylolysis and 4 had recurrent disc herniation. In 34 cases the arthodesis was limited to one level and in 6 it cases was done in 2 levels. Radiological fusion was demostrated in 95% of the cases. The clinical result was good to excellent in 88% of the patients. Two patients had pseudo-arthrodesis and one had transitory neuropraxia.

Humphreys et al.[14] made a comparative study of 34 PLIF with 40 TLIF cases. Of the 34 PLIF procedures, 13 were single level, 20 were double level and 1 was triple level. Of the 40 TLIF, 17 were single and 23 were double level. There were no complications with the TLIF patients. However, with the PLIF, there were 4 cases of radiculitis, 1 case of broken hardware, 1 case of screw loosening, 2 cases of screw removal, 1 nonunion requiring additional fusion, and 1 superficial wound infection. The authors concluded that the TLIF showed to be a good alternative to PLIF with relatively less risk of complications, less operating time and hospitalization, as well as significant reduction in blood loss during operation.

Hence, TLIF offers the advantage of being an efficient circumferencial arthrodesis through single access with the minimum risk of neural and dural lesion. At the same time, it allows posterior and foraminal decompression. Therefore, we believe that this technique should be promoted and properly employed in selected cases, specially when posterior decompression and circumferencial interbody

fusion of the lumbar region are necessary , as well as in many cases of DDD, recurrent disc herniation, spinal stenosis and low grade spondylolisthesis[13].

Our cases, even though limited in number, show an initial good experience with TLIF. Evaluation of the patients during the first 18 to 28 months after surgery showed improvement in 80% of the cases.

Therefore, we believe that this technique should be promoted and properly employed in selected cases, specially when posterior decompression and circumferencial fusion of the lumbar region are necessary. TLIF demonstrated its efficiency in treating cases of chronic lumbar pain with or without radiation to lower limbs, from DDD, recurrent disc herniation, low grade spondylolisthesis and iatrogenic segmental instability, specially when posterior decompression of the canal and vertebral foramen is indicated. The use of this technique should be encouraged to be performed by spine surgeons.

Acknowledgements - We would like to thank Professor Thomas Zdeblick, M.D. and Professor Clifford Tribus, M.D., from the University of Wisconsin, Madison, WI - USA. We also would like to thank Professor Odilon Silva and Elizabeth Duarte, from the Department of Statistcs of the University of Cuiaba, as well as Mr. John Hall for his translation of the text.

REFERENCES

1. Waddell G. An approach to backach. Br J Hosp Med 1982;28:187.
2. Mixter WJ, Barr JS. Rupture of intervertebral disc with involvement of the spinal canal. N Engl J Med 1934;211:210.
3. Crock HV. A reaprraisal of intervertebral disc lesions. Med J Aust 1970;1:983-989.
4. Freemont AJ, Peacock TE, Hoyland JA, O'Brien J, Jayson MIV. Nerve ingrowth into diseased intervertebral disc in chronic back pain. Lancet 1997;350:178-181.
5. Zdeblick TA. Discogenic back pain. In Rothman-Simeone (ed). The spine. Philadelphia: Saunders, 1999:749-765.
6. Zdeblick TA, Smith GR, Warden KE, et al. Two point fixation of the lumbar spine: differential stability in rotation. Spine 1991;16(Suppl 6):S298-S301.
7. Ray CD. Spinal interbody fusions: a review, featuring new generation techniques. Neurosurg Quarter 1997;7:135-156.
8. Zucherman J, Hsu K, Picetti G, et al. Clinical efficacy of spinal instrumentation in lumbar degenerative disc disease. Spine 1992;17:834-837.
9. Parker LM, Murrel AS, Boden SD, Horton WC. The outcome of posterolateral fusion in highly selected patients with discogenic low back pain. Spine 1996;21:1909-1917.
10. Bagby G. Arthrodesis by distraction-compression methods using a stainless steel implant. Orthopedics 1988;11:931-934.
11. Barrick WT, Schofferman JA, Reynolds JB, et al. Anterior lumbar fusion improves discogenic pain at levels of prior posterolateral fusion. Spine 2000;25:853-857.
12. Harms JG, Jeszenszky D. The unilateral, transforaminal approach for posterior lumbar interbody fusion. Orthop Traumatol 1998;2:88-89.
13. Tribus CB. Circumferencial fusion techniques. In Resnick DK, Haid RW (eds). The surgical management of low back pain. American Association of Neurological Surgeons, 2001:117-121.
14. Humphreys SC, Hodges SD, Patwardhan AG, Eck JC, Murphy RB, Covington LA. Comparison of posterior and transforaminal approaches to lumbar interbody fusion. Spine 2001;26:567-571.
15. Lowe T, Tahernia AD. Unilateral transforaminal posterior interbody fusion. Scoliosis Research Society Annual Meeting, San Diego, CA 1999.