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Posterior Lumbar Interbody Arthrodesis (PLIA) Using a Bone Graft

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Abstract

Lumbar arthrodesis is a common procedure. The method using an intersomatic graft via the posterior approach was described by Cloward [1] and popularized by Lerat [2] [3]. The current advent of intersomatic cases has caused this type of arthrodesis to decline. We operated on a series of patients who correspond to our beginnings for this type of surgery. The objective of our study is to assess the contribution of ALIP to the management of hyperalgic lumbar discopathies. The average age of our patients is 46 years. There were 4 men and 6 women. The pain presented as lumbar-radiculalgia in 7 patients. The arthrodesis was performed on the basis of hyperalgic discopathy. It concerned the L4-L5 disc in 7 cases, T12-L1 in 1 case and L5-S1 in one case. This discopathy was secondary to isthmic lysis in 05 cases, to a vicious L1 malunion in 01 case and was of degenerative origin in 04 cases. The average time of evolution was 16.5 months with extremes of 3 months and 48 months. All patients were operated under general anesthesia with orotracheal intubation. The approach was posterior for all our patients. The bone graft came from the posterior crest in 9 patients. All patients underwent arthrodesis at one level. It was done in L4-L5 in 70% of cases. A transpedicular osteotomy was performed for one patient. Posterior fixation was done using titanium screws and rods for all patients. The lumbar and radicular VAS, the Beaujon functional score and the Oswestry Disability Index (ODI) disability scale were globally improved for all patients. On the subjective level, 8 of the 9 patients evaluated were satisfied with the procedure despite complications such as dural breach, infection, radicular paralysis and junctional syndrome. ALIP allows for a high rate of

interbody fusion and indolence.

Keywords

Lumbar Spine, Arthrodesis, Interbody Fusion, Disc Disease

1. Introduction

Spinal arthrodesis is a surgical procedure that uses technical devices to immobilize a mobile and painful spinal segment by bone consolidation, while preserving the mobility of the rest of the spine.

Posterior lumbar interbody fusion (PLI) represents a first-choice indication. Long the gold standard, the use of bone graft has been supplanted by the advent of new biomedical materials in recent years [4] [5]. However, its use remains relevant due to its accessibility and good results.

The aim of our study was to evaluate the functional and radiological results of posterior lumbar interbody fusion using bone graft in the treatment of lumbar spine pathologies.

2. Material and Method

This is a retrospective study from January 1, 2016 to February 28, 2021, a duration of 62 months. We included all patients in whom a posterior interbody lumbar arthrodesis using a bone graft alone was performed.

There were 10 patients, including 4 men (40%) and 6 women (60%). The average age of the patients was 46 years with extremes of 18 years and 67 years.

Hyperalgesic discopathy was defined as intense mechanical lumbar pain linked to degenerative or sequelae pathologies (lumbar spine malunion, isthmic lysis).

Data collection was done using medical records, surgical protocols and hospitalization registers.

Data entry and analysis were carried out using Sphinx Plus 2 Software Version 5/2017. The graphs were made with Microsoft world Office 2018.

Nine patients were evaluated postoperatively with a mean follow-up of 36.89 months with extremes of 3 months and 60 months. One patient was lost to follow-up.

The functional assessment was based on:

- The visual analogue scale (VAS) to assess the intensity of pain;
- The Beaujon functional score and the Oswestry disability scale (ODI = Oswestry Disability Index);
- The patient's subjective satisfaction.

The imaging assessed:

- The restoration of disc height;
- Bone fusion.

The presence or absence of postoperative complications was also noted.

3. Results

3.1. Indications for Arthrodesis

Pain presented as lumbar-radiculalgia in 7 patients, pure lumbar pain in 2 patients and pure radiculalgia in 1 patient.

Arthrodesis was performed on the basis of hyperalgic discopathy. It involved the L4-L5 disc in 7 cases, T12-L1 in 1 case, L2-L3 in 1 case and L5-S1 in 1 case. This discopathy was secondary to isthmic lysis in 05 cases, to a vicious L1 malunion in 01 case and was of degenerative origin in 04 cases.

The mean time to progression was 16.5 months (range 3 months to 48 months).

3.2. Surgical Intervention

All patients were operated on under general anesthesia with orotracheal intubation. The approach was posterior for all our patients. Bone graft was from the posterior (Figure 1) crest in 9 patients. In one patient, the graft was prepared with grafts from the laminectomy.

All patients underwent single-level interbody fusion. It was done at L4-L5 in 70% of cases. A transpedicular osteotomy was performed for one patient. Posterior fixation was done using titanium screws and rods for all patients.

The number of levels set by the posterior instrumentation was unique for 7 patients, double for 2 patients and triple in one patient.

The average hospital stay was 17.7 days with extremes of 6 days and 41 days.

The comparison of the mean of the radicular and lumbar VAS in pre and postoperative period is shown in Table 1.

Figure 1. The patient is placed on a frame leaving the abdomen free, with the feet elevated. The iliac crest is approached via the same incision.

Table 1. Comparison of the mean of the Radicular and lumbar VAS in pre and post-operative period.

	Preoperative	Postoperative
Radicular VAS	3.25	1.38
Lumbar VAS	5.63	1.75

3.3. Complications

Acute complications were observed in 4 patients (40%):

—minimal skin necrosis with delayed healing;

—subcutaneous infection of the surgical wound requiring revision in the operating theatre;

—dysuria lasting several weeks reported by the patient who underwent OTP with secondary normalisation;

—unilateral sensorimotor neurological deficit along the L5 pathway; the patient did not wish to undergo further surgery and presented with persistent steppage.

Functional scores

We used the Beaujon functional score (Figure 2) and the Oswestry Disability Index (ODI) disability scale (Figure 3).

The patient satisfaction index is reported in Table 2.

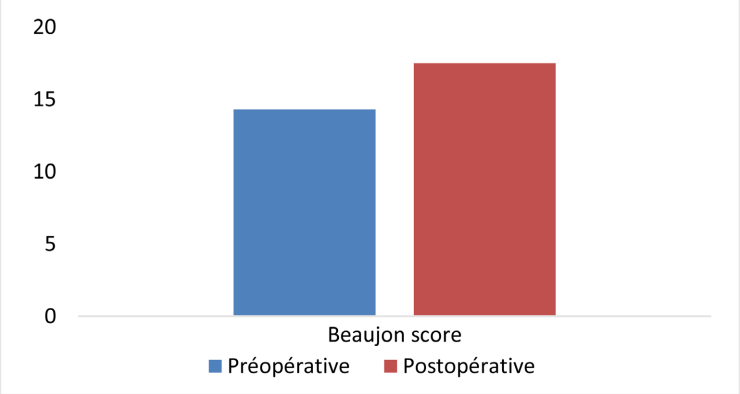

Figure 2. Pre- and post-operative comparison of the Beaujon score.

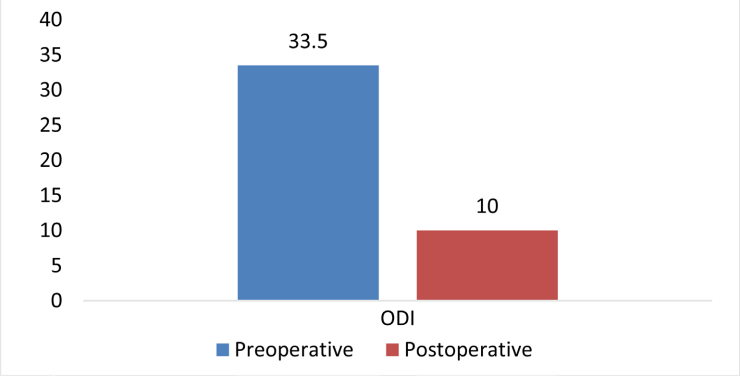

Figure 3. Pre- and postoperative comparison of the ODI scale.

Table 2. Patient satisfaction index repair.

	Number (n = 8)	Percentage (n =100)
Very satisfied	4	50%
Satisfied	3	37.5
Unhappy	1	12.5
Total	8	100%

3.4. Radiography

All patients evaluated (9/10) had consolidated at the last follow-up without disassembly of the material, nor fracture of the screw or rod (**Figure 4**). The average time to consolidation was 6.75 months with extremes of 3 and 12 months.

There were no variations in disc height in all patients.

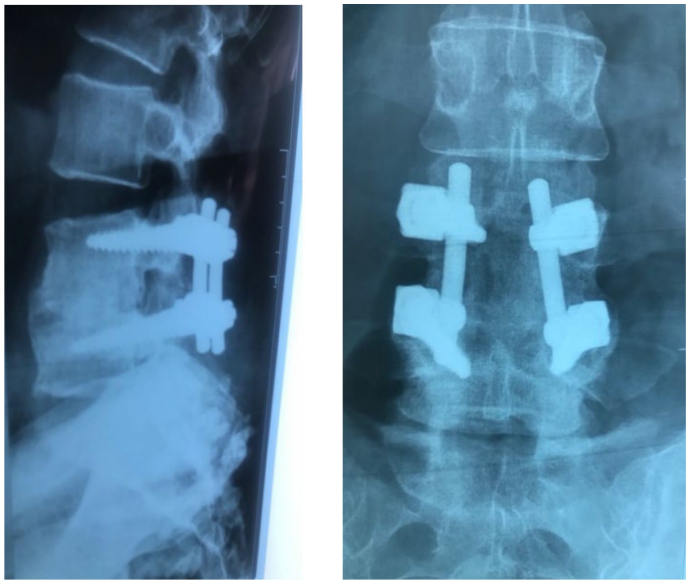

Figure 4. Pre- and postoperative comparison of the ODI scale.

3.5. Junctional Kyphosis

The evaluation at follow-up also allows us to note a case of junctional kyphosis. This is the patient who has the greatest follow-up. He presented with lumbar pain with a positive Caddie sign.

4. Discussion

4.1. Indications

We perform this procedure for advanced disc diseases such as spondylolisthesis by isthmic lysis, degenerative spondylolisthesis, degenerative disc diseases with disc crushing responsible for low back pain with radiculalgia. It can sometimes be a stenosis secondary to a discectomy or a vicious spinal cord injury. Some indications such as arthrodesis after discectomy or on discitis sequelae are much more

controversial [2] [6].

4.2. Surgical Procedure

The posterior approach is the one we use to approach our patients. The incision is vertical following the spinous processes as reported in most studies unlike Lerat [3] who makes a transverse incision. This approach allows us through a small approach under the TCSC to access the posterior crest for harvesting the interbody graft. After discectomy and preparation of the vertebral endplates, the iliac grafts are inserted via the posterior approach with impaction by a graft extractor. This approach is simple and now allows ALIF [7] and TLIF to be performed after arthrectomy [3].

There is an extracanal posterior approach [8]. This Wiltse approach allows:

- Respect for the integrity of the posterior arch and median ligament formations;
- The possibility of performing a bone graft in the paravertebral grooves;
- Exploration and release of the roots at the usually inaccessible part of the foramen.

The anterior and anterolateral approaches allow the disc to be distracted as much as possible, but they present a significant risk of vascular and nerve lesions [9] [10].

Combined approaches are also reported in the literature. This is often an intersomatic route by lumbotomy or anterior route [11] associated with posterior pedicle fixation, sometimes by minimally invasive route.

4.3. Postoperative Clinical and Radiological Assessment

The position of the graft that appears most valid for promoting bone consolidation is that where the graft is in compression and not subject to movement. This designates the center of movement located near the nucleus pulposis [2]. It therefore appears that intercorporeal grafts are the best placed from the point of view of consolidation.

The best grafts for obtaining good consolidation are therefore iliac grafts. This is a cancellous bone whose quality as a graft is recognized [2] [3]. It is notably used for intersomatic grafts of the cervical spine, during opening osteotomies of the limbs, during total hip arthroplasties. Autogenous iliac crest harvesting was hampered by donor site morbidity, with a reported complication rate of 2.8% to 39%, and long-term graft site pain persisting in 31% of patients [11] [12].

We used iliac crest grafts for 9 of our 10 patients and a laminectomy chip graft. It was the latter patient who presented with PES paralysis due to migration of a fragment at the transverse foramen with probable compression on the nerve root. We impact the grafts interbody after their introduction, using a graft extractor. We put in the maximum amount of graft without trying to fill the disc. This is one of the differences between interbody arthrodesis and the prosthesis which seeks to occupy the disc as much as possible. Many surgeons have accepted the use of bone substitutes because they offer an excellent fusion rate in anterior procedures

and avoid the morbidity of iliac grafts [13].

The posterolateral graft is also widely used, such as in scoliosis or in posterolateral arthrodesis on low-grade spondylolisthesis. It is now used in discopathies in addition to intersomatic grafts to have a 360˚ circumferential fusion.

In intersomatic, modern arthrodesis is performed by cage. These cages allow consolidation via bone grafts introduced into them and around them, in the disc. They also allow the disc to be distracted as much as possible to free the nerve roots trapped at the transverse foramen. The appearance of the cage depends on the approach.

We used iliac crest grafts because at the time we did not yet have intervertebral cages.

ALIP is a safe technique that allows an interesting consolidation rate. We obtained consolidation in all our patients evaluated (9 out of 10), with variable delay (3 months to 12 months). Lerat [2] reports a consolidation rate of 28/29 for spondylolisthesis by isthmic lysis. Rubini [14] reports a consolidation rate of 19/20.

Arthrodesis by cage gives very good consolidation rates. Inamdar [15] obtained consolidation in all his patients (PLIF). This rate is 96% for Kapustka [10] (ALIF) or Craig Humphrey [16].

Consolidation is achieved more easily as the number of grafted levels is reduced [17]. The use of autologous iliac graft seems to promote consolidation due to its high osteogenic capacity [18]-[20].

Arthrodesis did not allow us to restore disc height. The use of the intersomatic cage seems to be the current standard for good distraction and good restoration of disc height and sagittal parameters. However, some authors [21] maintain that there is no correlation between restoration of disc height and clinical results.

We noted a clear decrease in pain intensity with a lumbar VAS of 1.75 to 5.63 and a radicular VAS of 1.38 versus 3.25. This trend is found in most series such as that of Boissière [11] and that of Fritzel [22] and Lee [23]. The posterior approach provides good stabilization with complete decompression [3]. This could explain the marked decrease in low back pain and radiculalgia. Short arthrodesis gives the best results [2]. All our patients benefited from a single level of arthrodesis.

Four patients kept low back pain of moderate to low intensity at the last follow-up. Inamdar [15] in his series found a percentage of 20% of postoperative low back pain.

4.4. Functional Scores

On average, we noted a significant improvement in the ODI score and Beaujon score, with a postoperative gain of 3.2 points.

Some previous studies [21] [24] [25] have demonstrated the superiority of the clinical results of posterior interbody arthrodesis compared to other types of arthrodesis. Our good results could also be explained by the fact that our population is relatively young with an average age of less than 60 years as demonstrated by Lee [23].

We obtained 87.5% of very satisfied and satisfied patients after surgery.

4.5. Complications

Spinal surgery is very prone to complications. Some of these complications can be life-threatening (vascular lesions) while others can be functionally hazardous (spinal cord and root lesions).

One of our patients presented with L5 paralysis, certainly due to migration of an intersomatic graft fragment into the transverse foramen. This patient did not want to repeat the surgical procedure for nerve decompression. This is why we preferred to use iliac grafts for the graft.

We had a case of dural breach. This breach was due to an exaggerated gap between the spinal cord and the root on the one hand and the forced passage of a large-caliber bone graft. The repair was done by a direct and watertight suture. This is a common complication of spinal surgery with an estimated rate of between 3% and 5%. The management of these breaches consists of a direct suture or a reinforced suture (muscle, fat). The use of products such as biological glue is increasingly frequent to reinforce and protect these sutures. It is then recommended not to drain or to drain in a rag. Infection of the surgical site was found in one of our patients. It was a persistent discharge from the iliac graft harvesting site. This is a serious complication with a mortality rate of up to 3%.

5. Conclusions

Posterior interbody lumbar arthrodesis using an iliac graft is an arthrodesis technique that has stood the test of time. Its principles were first described by Cloward [1]. Then Lerat [2] [3] promoted it. The development of technical means such as pedicle fixation has simplified the contention that accompanies it.

We adopted it because of the simplicity of its posterior approach and the low cost of the surgical procedure. In 6 years, we have operated on 10 patients using this technique. We obtained interbody fusion for all our patients evaluated at follow-up (9/10).

Satisfaction is also noted for all patients except one.

The availability of implants such as interbody cages has reduced the current indications. But it remains a possibility to obtain a good fusion at a lower cost.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Cloward, R.B. (1953) The Treatment of Ruptured Lumbar Intervertebral Discs by Vertebral Body Fusion. *Journal of Neurosurgery*, **10**, 154-168. https://doi.org/10.3171/jns.1953.10.2.0154

[2] Lerat, J.L., Basso, M.P., Moyen, B. and Bochu, M. (1987) Arthrodèse lombaire intersomatique postérieure (ALIP) comparaison avec les autres méthodes d'arthrodèse:

Techniques, Indications, Résultats. Cahiers d'enseignement de la SOFCOT, Conférences d'enseignement, 275-322.

[3] Lerat, J.L., Rubini, J., Besse, J.L., Moyen, B. and Lecuire, F. (1996) Arthrodèse lombaire interso-matique par voie postérieure par greffe iliaque pure selon la technique de Lerat; restabilisation intersomatique du rachis lombaire. Sauramps Medical, 67-74.

[4] Nzanzu, J., Fomekong, E., Dufrane, D. and Raftopoulos, C. (2014) Induction of Lumbar Interbody Fusion by Autologous Osteodifferenciated Stem Cells: Preliminary Results. *Neurochirurgie*, **60**, Article 321. https://doi.org/10.1016/j.neuchi.2014.10.004

[5] Vouaillat, H. (2015) Arthrodèses cervicales et lombaires utilisant une cage intersomatique avec greffon osseux allogénique enrichi en concentré de moelle osseuse. Maitrise Orthopédique. https://www.maitrise-orthopedique.com/11-e28e-kcbs/

[6] Varatharajah, S., Charles, Y.-P., Buy, X., Walter, A. and Steib, J. (2014) Traitement chirurgical actuel du mal de Pott. *Revue de Chirurgie Orthopédique et Traumatologique*, **100**, 187-193. https://doi.org/10.1016/j.rcot.2013.10.092

[7] Le Huec, J.C., Belliard, R., Liquois, F., Husson, J.L. and Choucroun, E. (1996) A Le Rebeller, abord de la colonne lombaire par retropéritonéoscopie; restabilisation intersoma-tique du rachis lombaire. Sauramps Médical, 121-127.

[8] Henry, P. and Doursounian, L. (1996) Voie postérieure extracanalaire pour abord du rachis lombaire; restabilisation intersomatique du rachis lombaire. Sauramps Médical, 96-100,

[9] Mobbs, R.J., Phan, K., Malham, G., Seex, K. and Rao, P.J. (2015) Lumbar Interbody Fusion: Techniques, Indications and Comparison of Interbody Fusion Options Including PLIF, TLIF, MI-TLIF, OLIF/ATP, LLIF and ALIF. *Journal of Spine Surgery*, **1**, 2-18.

[10] Kapustka, B., Kiwic, G., Chodakowski, P., Miodoński, J.P., Wysokiński, T., Łączyński, M., *et al.* (2019) Anterior Lumbar Interbody Fusion (ALIF): Biometrical Results and Own Experiences. *Neurosurgical Review*, **43**, 687-693. https://doi.org/10.1007/s10143-019-01108-1 http://link.springer.com/10.1007/s10143-019-01108-1

[11] Boissiere, L., Perrin, G., Rigal, J., Michel, F. and Barrey, C. (2013) Lumbar-Sacral Fusion by a Combined Approach Using Interbody PEEK Cage and Posterior Pedicle-Screw Fixation: Clinical and Radiological Results from a Prospective Study. *Orthopaedics & Traumatology*: *Surgery & Research*, **99**, 945-951. https://doi.org/10.1016/j.otsr.2013.09.003 https://linkinghub.elsevier.com/retrieve/pii/s1877056813002107

[12] Sasso, R.C., LeHuec, J.C. and Shaffrey, C. (2005) Iliac Crest Bone Graft Donor Site Pain after Anterior Lumbar Interbody Fusion: A Prospective Patient Satisfaction Outcome Assessment. *Journal of Spinal Disorders & Techniques*, **18**, S77-S81. https://doi.org/10.1097/01.bsd.0000112045.36255.83

[13] Hives, F. (2017) Évaluation en scintigraphie osseuse TEMP/TDM des facteurs prédictifs de la reprise chirurgicale de l'arthrodèse vertébrale rigide. Thèse pour le diplôme d'état de Docteur En Médecine, Université du Droit et de la Sante-Lille 2, Faculté De Médecine Henri Warembourg.

[14] Rubini, J., Lerat, J.L., Besse, J.L., Moyen, B., Galland, O. and Lecuire, F. (1996) Traitement des spon-dylolisthesis de grand glissement par réduction postérieure et arthrodèse lombaire inter-somatique par voie postérieure a propos de 20 cas restabilisation intersoma-tique du rachis lombaire. Sauramps Médical, 145-151.

[15] Inamdar, D., Alagappan, M., Shyam, L., Devadoss, S. and Devadoss, A. (2006) Posterior Lumbar Interbody Fusion versus Intertransverse Fusion in the Treatment of Lumbar Spondylolisthesis. *Journal of Orthopaedic Surgery*, **14**, 21-26. https://doi.org/10.1177/230949900601400106

[16] Craig Humphreys, S., Hodges, S.D., Patwardhan, A.G., Eck, J.C., Bryan Murphy, R. and Covington, A.L.A. (2001) Comparison of Posterior and Transforaminal Approaches to Lumbar Interbody Fusion. *Spine*, **26**, 567-571. https://doi.org/10.1097/00007632-200103010-00023

[17] Le Huec, J.C., Liquois, F., Desperiez, M., Chauveaux, D. and Le Rebeller, A. (1996) Biomécanique des arthrodèses lombaires et lombo-sacrées. Restabilisation intersomatique du rachis lombaire. Sauramps Médical, 60-65.

[18] Hutter, C.G. (1983) Posterior Intervertebral Body Fusion a 25-Year Study. *Clinical Orthopaedics and Related Research*, **179**, 86-96. https://doi.org/10.1097/00003086-198310000-00013

[19] Takeda, M. (1985) Experience in Posterior Lumbar Interbody Fusion. *Clinical Orthopaedics and Related Research*, **193**, 120-126. https://doi.org/10.1097/00003086-198503000-00015 https://europepmc.org/article/med/3882291

[20] Lin, P.M. (1985) Posterior Lumbar Interbody Fusion Technique. *Clinical Orthopaedics and Related Research*, **193**, 90-102. https://doi.org/10.1097/00003086-198503000-00012 https://journals.lww.com/clinorthop/abstract/1985/03000/posterior_lumbar_interbody_fusion_technique_.12.aspx

[21] Lidar, Z., Beaumont, A., Lifshutz, J. and Maiman, D.J. (2005) Clinical and Radiological Relationship between Posterior Lumbar Interbody Fusion and Posterolateral Lumbar Fusion. *Surgical Neurology*, **64**, 303-308. https://doi.org/10.1016/j.surneu.2005.03.025 https://linkinghub.elsevier.com/retrieve/pii/s0090301905001989

[22] Fritzell, P., Hägg, O., Wessberg, P. and Nordwall, A. (2002) Chronic Low Back Pain and Fusion: A Comparison of Three Surgical Techniques. *Spine*, **27**, 1131-1141. https://doi.org/10.1097/00007632-200206010-00002 http://journals.lww.com/00007632-200206010-00002

[23] Lee, C.S., Hwang, C.J., Lee, D., Kim, Y. and Lee, H.S. (2011) Fusion Rates of Instrumented Lumbar Spinal Arthrodesis According to Surgical Approach: A Systematic Review of Randomized Trials. *Clinics in Orthopedic Surgery*, **3**, Article 39. https://doi.org/10.4055/cios.2011.3.1.39

[24] Wu, Y., Tang, H., Li, Z., Zhang, Q. and Shi, Z. (2011) Outcome of Posterior Lumbar Interbody Fusion versus Posterolateral Fusion in Lumbar Degenerative Disease. *Journal of Clinical Neuroscience*, **18**, 780-783. https://doi.org/10.1016/j.jocn.2010.10.012

[25] Kim, K., Lee, S., Lee, Y., Bae, S. and Suk, K. (2006) Clinical Outcomes of 3 Fusion Methods through the Posterior Approach in the Lumbar Spine. *Spine*, **31**, 1351-1357. https://doi.org/10.1097/01.brs.0000218635.14571.55