Autograft alone versus autograft enhanced with platelets rich plasma in posterolateral fusion for lytic spondylolisthesis
A randomized clinical trial

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Abstract

Objectives

To analyze the effectiveness using autologous bone graft enhanced with platelet-rich plasma (PRP) in posterolateral fusion for lytic spondylolisthesis.

Patients and Methods

This randomized clinical study included 40 patients with lytic spondylolisthesis. They were equally randomized into one of two treatment groups: PRP group (n=20) was submitted to instrumented posterolateral fusion using autologous bone graft plus PRP injection and control group (n=20) was submitted to instrumented posterolateral fusion using autologous bone graft alone. All patients were functionally assessed by the Oswestry disability index. Bony fusion was assessed after 12 months using the bridging trabecular bone scale that combines data obtained from plain radiographs and CT scans. The mean duration of follow up period was 18 (12-20) months. One patient was lost to follow up in each group.

Results

Preoperatively, there was no significant differences between the studied groups regarding the functional performance. While patients in each group showed significant improvement of functional performance over the follow up period, no significant differences were noted between the studied groups at 3, 6 and 12 months of follow up. Also, at 12 months postoperatively, there was no significant difference between the studied groups regarding bridging trabecular bone scale.

Conclusions

PRP used with autologous bone substitute have no effect on functional outcome and the rate of fusion.

Keywords

PRP, Posterolateral fusion, lytic spondylolisthesis, autologous bone graft.

Introduction

Pseudoarthrosis is frequently encountered during spinal fusion surgeries[(1)]. Sometimes, revision surgery is required to attempt arthrodesis[(2)]. However, patients with chronic conditions e.g. smokers, diabetics, rheumatoid arthritis patients or those receiving anti-inflammatory medications may experience delayed graft healing [(3)]. On the other hand, use of allografts may be associated with increased rate of pseudoarthrosis[(4)].

Platelets are a key component of the initial cellular response in tissue repair. They migrate to the injury site and release a variety of growth factors. The early platelet-mediated activity induces formation of a fibrin clot as well as chemotaxis of white blood cells and stem cells. Platelet degranulation and release of platelet-derived growth factor, transforming growth factor-beta, and vascular endothelial growth factor are among the signaling substances known to be important in bone healing. These mechanisms are behind the development of the use of platelets in multiple types of healing processes. In orthopedics, platelets-enriched plasma (PRP) was used to enhance the healing properties of bone by stimulating osteoinduction and mitogenesis[(5)]. However, utilization of PRP in spinal fusion in not frequent and reported results were controversial[(6,7)].

The present study aimed to investigate the possible role of PRP in improving functional scale and enhancing bony fusion rate during posterolateral fusion surgery for lytic spondylolisthesis.

Patients and Methods:

The present prospective study was conducted at Orthopedic Department, Cairo University Hospitals, Cairo, Egypt. The study protocol was approved by the local ethical committee and all patients gave informed consent before participation.

The study included 40 patients with single level lytic spondylolisthesis, spondylolisthesis level was L5 S1 in 17 patients in each group, L4-5 in 3 patients in each group. They were equally randomized into one of two treatment groups: PRP group (n=20) was submitted to instrumented posterolateral fusion using autologous bone graft plus PRP added to the graft and control group (n=20) was submitted to instrumented posterolateral fusion using autologous bone graft alone. Randomization was achieved using computer generated numbers and sealed envelope technique. The randomization process and patients allocation to

treatment groups was performed by an independent researcher who wasn't aware of the nature of the study. Preoperatively, all patients were subjected to careful history taking and thorough clinical and neurological examination. Radiological evaluation included plain radiography (AP and lateral views) and MRI of the spine and spinal canal.

Surgical technique

Preoperatively, patients received antibiotic prophylaxis (sulperazone 1.5 gm). Under general hypotensive anesthesia with patients in the prone position, a posterior midline incision was made. The spine was exposed and the level of surgery was verified radiologically via c-arm. Segmental instrumentation was then done in the form of bilateral pedicle screws and contoured rods under fluoroscopic guidance. The appropriate screw length was chosen and inserted. This was repeated then at all levels to be fused bilaterally. Then, rods were contoured and placed bilaterally. Final position of instrumentation was verified radiologically in multiple planes. Dissection was done with electrocautery down to the transverse processes to be fused. The facet joint was denuded by removing fascia covering it and then the recipient site for grafting was prepared by decortications of graft bed bilaterally. Irrigation of wound was done using normal saline ensuring hemostasis, the autogenous bone graft obtained from the removed laminae was cut into small fragments.

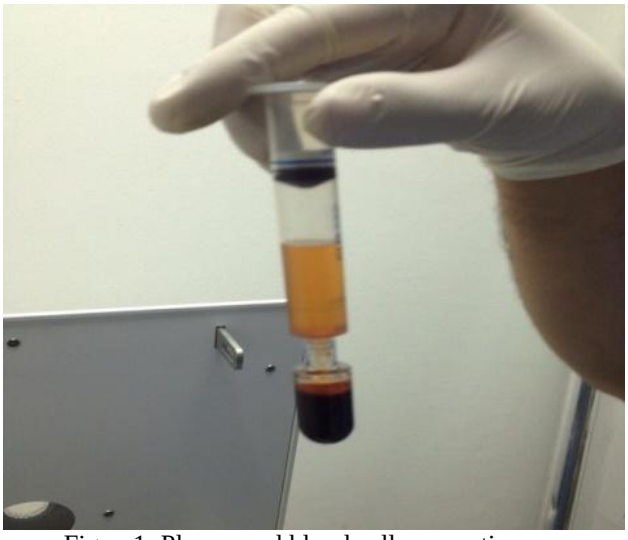

Figure1: Plasma and blood cells separation.

PRP preparation is done by withdrawing 10 cm whole blood from the patient via a butterfly cannula, First time centrifugation was then done at speed of 1200 RCF for 5 minutes to separate the blood cells in the bottom from the plasma on the top The blood cells were then removed being concentrated in the bottom, then second time centrifugation is done at speed of 1200 RCF for 10 minutes to separate the platelet rich plasma in the bottom from the platelet poor plasma on the top. PRP was added if indicated. The graft is placed in posterolateral gutter bilaterally. The wound was closed then in layers with drain. Gel foam is placed over exposed dura.

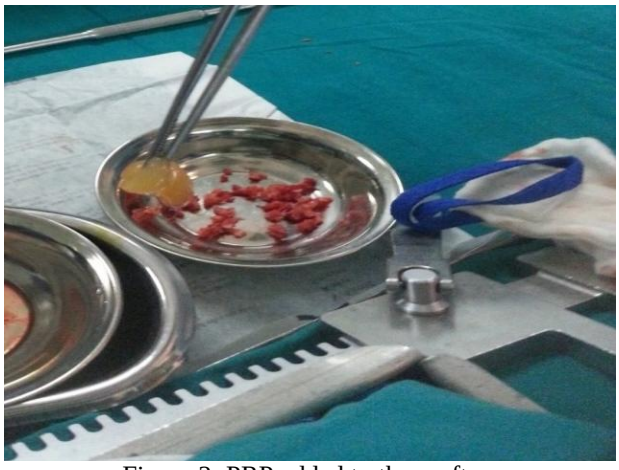

Figure 2: PRP added to the graft.

Postoperatively, patients received appropriate antibiotic and analgesic medications. Patients were mobilized in a lumbosacral brace from the second day for 3 months. Patients were instructed to avoid lifting heavy objects and smoking.

Functional evaluation was done preoperatively and at 3, 6 and 12 months postoperatively using the Arabic version of Oswestry disability Index (ODI) [8]. Bony fusion was assessed after 12 months using the bridging trabecular bone scale that combines data obtained from plain radiographs and CT scans[9].The mean duration of follow up period was 18 (range: 12-20) months. One patient was lost to follow up in each group.

Data obtained from the present study was presented as mean ± standard deviation or number and percent. Numerical variables were compared using t test while categorical variables were compared using chi-square test. P value less than 0.05 was considered statistically significant. Statistical calculations were achieved using SPSS 25 (IBM, USA).

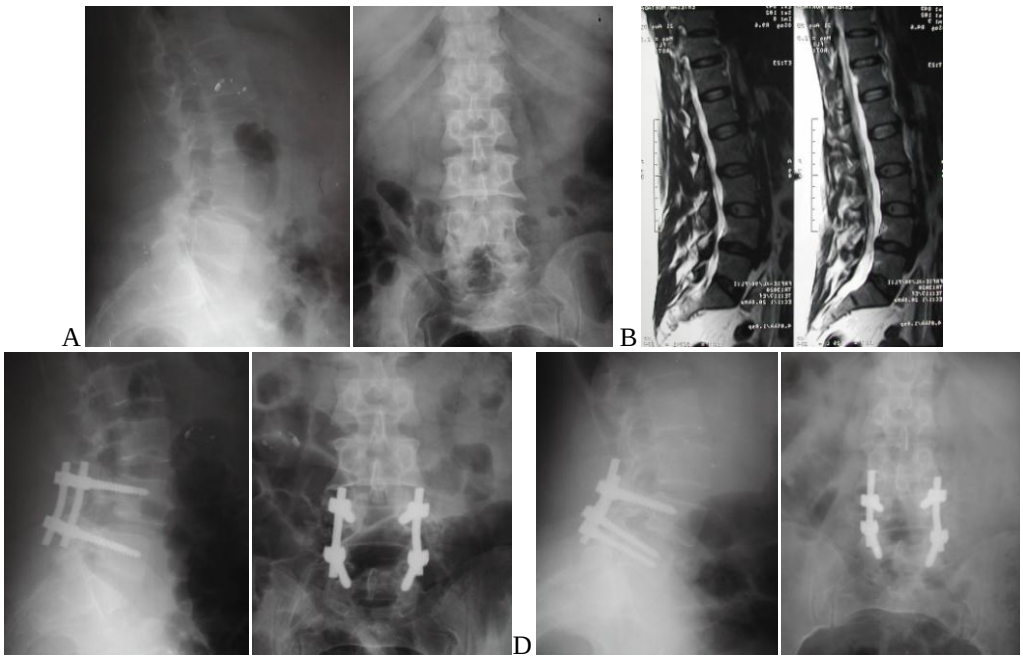

Figure 3: Shows radiology of a 60 years old female patient, her body mass index was 34.6, she has lytic spondylolisthesis L4-L5. Surgery done on January 2016 Preoperative ODI was 50 and at last follow up was 20. A- Preoperative X-rays. B- Preoperative MRI.C- Postoperative X-rays. D- 12 months postoperative X-rays.

Results:

Patients included in the studied groups were comparable regarding age, BMI and sex distribution (Table-1)

Preoperatively, there were no significant differences between the studied groups regarding the functional performance. While patients in each group showed significant improvement of functional performance over the follow up period, no significant differences were noted between the studied groups at 3, 6 and 12 months of follow up (Table-2).

Table-1: Demographic data in the studied groups.

	PRP group N=19	**Control group** N=19	**P value**
Age (years)	59.5 ± 5.8	58.3 ± 7.4	0.79
Male/female	7/12	7/12	1.0
BMI (Kg/m^2)	32.3 ± 4.9	30.9 ± 5.4	0.64

Table-2: Baseline data of the studied patients.

	PRP group N=19	**Control group** N=19	**P value**
Preoperative ODI			
Minimal disability	-	-	
Moderate disability	10 (52.6)	7 (36.8)	0.4
Severe disability	9 (47.4)	11 (57.9)	
Crippled	-	1 (5.3)	
Postoperative ODI at 3 months			
Minimal disability	11 (57.9)	10 (52.6)	
Moderate disability	8 (42.1)	9 (47.4)	0.5
Severe disability	-	-	
Crippled	-	-	
Postoperative ODI at 6 months			
Minimal disability	13 (68.4)	11 (57.9)	
Moderate disability	6 (31.6)	8 (42.1)	0.37
Severe disability	-	-	
Crippled	-	-	
Postoperative ODI at 12 months			
Minimal disability	13 (68.4)	13 (68.4)	
Moderate disability	6 (31.6)	6 (31.6)	1.0
Severe disability	-	-	
Crippled	-	-	
P value	< 0.001	< 0.001	

Also, at 12 months postoperatively, there was no significant difference between the studied groups regarding bridging trabecular bone scale (Table-3).

Table-3: Postoperative bridging trabecular bone scale at 12 months.

Bridging trabecular bone scale	PRP group N=19	Control group N=19	P value
0 %	-	-	0.78
1-25 %	-	-	
26-50 %	-	-	
51-75 %	8 (42.1)	7 (36.9)	
76-99 %	8 (42.1)	10 (52.6)	
100 %	3 (15.8)	2 (10.5)	

Discussion

In this randomized clinical study, we performed decompression and instrumented fusion surgery for 40 patients with lytic spondylolisthesis using posterolateral autograft plus PRP or posterolateral autograft alone. Patients in both groups showed significant functional and radiological improvement at the end of follow up with no significant differences between both groups.

In support of our results, Hee et al. compared use of autologous growth factors (AGF) in spinal fusion to a historical cohort without use of AGF. No significant differences were found between both groups regarding the fusion rate or pseudoarthrosis rate. However, they demonstrated faster fusion in patients using AGF[(6)].

Acceleration of fusion by the aid of PRP was also shown in the study of Roberto Tarantino et al. who evaluated 20 consecutive patients submitted to posterolateral arthrodesis with implantation of cancellous bone substitute soaked with PRP on one hemifield and cancellous bone substitute soaked with saline solution on the other hemifield. At 6 months, results demonstrated increased bone density using PRP[(10)].

Also, the randomized clinical study of Sys et al. agreed with our conclusions. In their work, adding PRP in posterior lumbar interbody fusion did not lead to a substantial improvement or deterioration when compared with autologous bone only[(11)]. In another study, Carreon et al. retrospectively compared iliac crest autograft alone and iliac crest autograft in combination with platelet gel for one, two and three level posterolateral lumbar fusion. At a minimum of 2 years follow-up in 76 patients utilizing CT scan and exploration during revision surgery, there was a 25 % nonunion rate for patients in the platelet gel group, while the iliac crest alone group experienced a 17 % nonunion rate. This difference was not statistically significant [(7)]

Moreover, Tsai et al. prospectively studied 34 patients who underwent posterolateral lumbar fusion with the addition of platelet gel to autologous bone graft. At 2 years follow-up with dynamic radiographs and CT scan, the nonunion rate was 15 % in the platelet gel group, compared to 10 % in the control group. Thus, the authors concluded that platelet gel does not enhance fusion. [(12)]

Conclusion

The present study found no added value of PRP use in lumbar fusion surgery.

Disclosures
Conflict of interest: None
Funding: None

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