

Platelet-Rich Plasma in Lower Extremity Bone Grafting

Clinical Papers Review

Introduction

Positive clinical evidence of the use of platelet-rich plasma (PRP) as an effective adjuvant to bone grafting procedures in the foot and ankle have recently been published. The following literature summaries examine the roll of PRP in tibial osteotomy¹, Charcot arthropathy², and flatfoot deformity correction³.

Published Clinical Articles

High Tibial Osteotomy

Enhanced Tibial Osteotomy Healing with Use of Bone grafts Supplemented with Platelet Gel or Platelet Gel and Bone Marrow Stromal Cells

Dallari, D., Savarino, L., Stagni, C., Cenni, E., Cenacchi, A., Fornasari, P.M., Albisinni, U., Rimondi, E., Baldini, N., and Guinti, A.

- Significantly higher osseointegration with PRP
- Platelet gel and bone marrow augmented graft displayed fastest osseointegration process
- Complete clinical and functional evidence of healing at 12 months

This study evaluated the osteogenic potential of lyophilized bone chips hydrated with platelet gel (Group A), platelet gel plus bone marrow (Group B) or control (Group C). Thirty-three patients were randomly assigned to one of the three treatment groups and underwent a high tibial osteotomy.

Osseointegration, the process of bone integration between native bone tissue and implant material, was significantly more developed groups A and B compared to controls at the six-week follow-up. By twelve weeks, Group B exhibited a higher rate of osseointegration than Group A.

Histological specimens taken at six weeks revealed no evidence of acute or chronic infection surrounding any of the bone grafts of each group. Group A exhibited extensive bone formation throughout the defect and was characterized by discrete amounts of bone marrow-like tissue filling the voids between bone chips, new linings of osteoblasts in the trabeculae, and the presence of vascular buds. In comparison, Group B specimens were characterized by a more advanced remodeling process denoted by the presence of mature bone and a rich existence of vascular buds supported by greater revascularization. Furthermore, the number of osteoblasts and osteoid areas were not significantly different between Groups A and B, but were significantly increased compared to controls. Bone apposition on chips was significantly increased in Groups A and B compared to controls, but Group B demonstrated the highest percentage of bone apposition.

Conclusion: The authors concluded that “adding a platelet gel or a platelet gel combined with bone marrow stromal cells to lyophilized bone chips increases the osteogenic potential of the lyophilized bone chips and may be a useful tool in the treatment of patients with massive bone loss.”

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Charcot Arthropathy

Use of platelet-rich concentrate and bone marrow aspirate in high-risk patients with Charcot arthropathy of the foot

Pinzur, Michael S.

- 91.3% exhibited radiographic union at the 16 week follow-up.
- Eradication of bony infection in favorable outcome patients
- Favorable clinical outcomes maintained throughout follow-up

Forty-four high-risk diabetic patients averaging 55 years old and a body mass index of 38, underwent surgical correction in 46 feet for Charcot foot arthropathy. Patients were classified as high-risk if they were considered immunodeficient, morbidly obese, had chronic draining osteomyelitis at the deformity, or had multiple diabetic co-morbidities. Twenty-eight patients (61%) had open wounds with chronic draining osteomyelitis.

Surgical correction first returned the foot to plantigrade ankle position by tendoachilles or gastrocnemius muscle lengthening. Second, deformity correction was accomplished by bone excision at the deformity and the infected bone removed.

At the time of surgery, 2 – 3 cc's of bone marrow was aspirated from the iliac crest and combined with platelet-rich plasma (PRP) processed from 60

cc's of anticoagulated blood. At the time of closure, the PRP was mixed with thrombin and calcium chloride and injected into the infusion site along with the bone marrow aspirate. External fixation was maintained postoperatively.

Forty-two of 46 feet (91.3%) displayed favorable outcomes assessed through radiographic evidence of bony union 16-weeks postoperatively. By 26 months postoperatively, all favorable outcome patients had resolved the open wounds with chronic draining osteomyelitis.

Four patients had unfavorable outcomes. One patient died of unrelated causes, two persistent infections required amputation, and one had a persistent full-thickness plantar ulcer even though bony union was achieved.

Conclusion: More than 90% of this high-risk population achieved a favorable outcome of clinical and radiographic bony union, eradication of bony infection, and positive ambulatory status.

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Flatfoot Deformity

The use of tricortical autograft versus allograft in lateral column lengthening for adult acquired flatfoot deformity: an analysis of union rates and complications

Grier, K.M. and Walling, A.K.

- 94% successful union achieved with allograft plus PRP (70% union rate with autograft).
- 35% (allograft plus PRP) vs. 65% (autograft) complication rate
- Allograft + PRP therapy reduced hospital stay 1.1 days on average
- PRP from whole blood was prepared with Biomet Biologics' GPS separator

The graft of choice for lateral column lengthening procedures has historically been autograft. This retrospective study compared iliac tricortical allograft hydrated with PRP and iliac tricortical autograft in lateral column lengthening procedures between 1996 and 2006.

A retrospective review of 33 calcaneocuboid lengthening arthrodeses and 18 Evan's calcaneal lengthening osteotomy procedures was performed. Twenty procedures used tricortical autograft and 31 procedures used tricortical allograft hydrated with PRP processed by Biomet Biologics' GPS separator.

This study showed that 29 of 31 patients (94%) progressed to union with the tricortical allograft hydrated in PRP compared to 14 of 20 patients

(70%) progressing to union with tricortical autograft.

Eleven of 31 allograft patients (35%) had documented complication other than nonunion and all complications were minor in nature. Thirteen of 20 autograft patients (65%) also had a documented complications other than nonunion including two major complications associated with the autograft harvest site. Overall, four of the complications were associated with the autograft donor site.

Finally, the average hospital stay for patients with an allograft procedure was 2.5 days compared to 3.6 days for patients with an autograft procedure. The authors noted that the additional hospital time associated with the autograft group was due to additional pain from the graft harvest site.

Conclusion: The authors concluded that their results indicated that "equivalent if not better healing and complication rates are possible with the use of allograft with PRP versus autograft for lateral column lengthening procedures while allowing for similar correction of deformity."

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Reference List

- (1) Dallari D, Savarino L, Stagni C et al. Enhanced tibial osteotomy healing with use of bone grafts supplemented with platelet gel or platelet gel and bone marrow stromal cells. *J Bone Joint Surg Am* 2007 November;89(11):2413-20.
- (2) Pinzur MS. Use of platelet-rich concentrate and bone marrow aspirate in high-risk patients with charcot arthropathy of the foot. *Foot Ankle Int* 2009 February;30(2):124-7.
- (3) Grier KM, Walling AK. The use of tricortical autograft versus allograft in lateral column lengthening for adult acquired flatfoot deformity: an analysis of union rates and complications. *Foot Ankle Int* 2010 September;31(9):760-9.

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