THE USE OF PLATELET RICH PLASMA WITH BONE MARROW ASPIRATE IN PUDDU TIBIAL OSTEOTOMY

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ABSTRACT

Objective: The present study was performed in order to evaluate the use of platelet rich plasma associated to bone marrow aspirate, substituting autologous iliac bone graft in medial opening wedge osteotomy (OWHTO). Methods: Twenty-five patients were submitted to tibial opening wedge osteotomy, being divided into two groups. Iliac group: 14 patients submitted to OWHTO, using autologous iliac bone graft to fill the gap. PRP group: 11 patients using platelet rich plasma associated to bone marrow aspirate to fill the gap. We evaluated bleeding (hemoglobin and hematocrit levels) and pain (visual analogic scale-VAS), then we compared the groups regarding these variables. Results: Differences between the groups were not found regarding hemoglobin levels (p=0.820) and hematocrit levels (p=0.323). The groups were not different regarding pain measured with VAS (p=0.538). Conclusion: The use of platelet rich plasma associated to bone marrow aspirate in medial opening wedge osteotomy did not offer advantages over autologous iliac bone graft regarding bleeding and pain.

Keywords *– Platelet rich plasma; Osteotomy; Tibia; Bone substitutes*

INTRODUCTION

Platelet-rich plasma (PRP) refers to a preparation obtained from autologous blood. Inside platelets, there are granules filled with growth factors, among the most important are platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β) and vascular endothelial growth factor (VEGF)[1,2].

Growth factors are polypeptides that are usually synthesized by specific tissues and act as local regulators of cellular function. These growth factors bind to receptors on the target cell membrane, activating an intracellular process that produces proteins to be used within the cell or exported[3].

The normal concentration of platelets in peripheral blood is from 150,000/µl to 350,000/µl on average. For the PRP to be most efficiency, platelet concentration should be around 1,000,000/µl[1,2,4]. There are several methods for obtaining PRP[5], each with its peculiar ability to concentrate the platelets, as well as in the release of growth factors by platelets.

The clinical use of PRP has grown considerably and has been applied in various situations: knee arthroplasty (TKA), tendon repair, treatment of cartilage lesions, and as a bone substitute[6-16]. PRP has been shown to reduce bleeding, pain, and the occurrence of arthrofibrosis when applied in the perioperative period in TKA[6,7].

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The present study aims to evaluate the results with regard to pain and bleeding obtained with the application of PRP in the proximal tibial osteotomies by addition of a medial wedge (TOAMW).

METHODS

This study was approved by the Research Ethics Committee of the Universidade de São Paulo. All patients signed an informed consent form.

The criteria for inclusion in the study were patients with varus knee deformity evaluated using a panoramic weight-bearing radiograph of the lower limbs, patients between 25 and 60 years of age, absence of systemic inflammatory diseases (rheumatoid arthritis, lupus, etc.), body mass index (BMI) less than 30kg/m^2[17], need for correction with the use of wedges between 10 mm and 15 mm. Diagnosis of unicompartmental osteoarthritis, chronic ligament deficiencies, or deformities of the lower limbs. The indications for valgus osteotomy complied with those recommended in the literature[18-20].

The exclusion criteria were loss to follow-up and patient request to be excluded from the study. We studied 25 patients randomly divided into two groups by drawing lots with replacement performed on the day surgery had been scheduled. All surgical procedures in this study were performed by the same surgeon.

Patients were separated into two groups. The iliac group (IG) was comprised of 14 patients who underwent osteotomy with the use of an autologous iliac graft at the osteotomy site. The PRP group (PRPG) was comprised of 11 patients who underwent osteotomy with the use of a bone substitute composed of platelet-rich plasma (PRP) and bone marrow aspirate. We called this bone substitute "biological bone graft".

The most frequent diagnosis in the two groups was chronic injury of the anterior cruciate ligament (ACL) (Table 1).

Table 1 – Distribution of patients in the iliac and PRP groups according to diagnosis.

		Group		TOTAL
		Iliac	PRP	
Diagnosis p = 0.168	Chronic injury of the ACL1	6	9	15
		42.9%	81.2%	60.0%
	Medial OA2	5	1	6
		35.7%	9.1%	24.0%
	Deformities3	3	1	4
		21.4%	9.1%	16.0%
Total		14	11	25
		100%	100%	100%

P value regarding the Fisher's exact test.
1Double varus or triple varus.
2Also includes osteonecrosis.
3Genu varus or fracture sequela.

The groups were homogeneous with regard to the size of the wedges used (Table 2).The average age of the patients in the iliac and PRP groups was 45.9 and 37.8 years, respectively (p = 0.014).The technique employed to perform the osteotomy was, as noted earlier, the addition of a medial wedge, similar to the planning and surgical technique described by Puddu et al.[19,20].

Table 2 – Distribution of patients in the iliac and PRP groups according to size of the wedge used.

		Group		TOTAL
		Iliac	PRP	
Wedge size p = 0.885	10.0 mm	5	3	8
		35.7%	27.3%	32.0%
	12.5 mm	5	5	10
		35.7%	45.5%	40.0%
	15.0 mm	4	3	7
		28.6%	27.3%	28.0%
TOTAL		14	11	25
		100%	100%	100%

P value regarding the Fisher's exact test.

After osteotomy and plate fixation, the space created in the metaphyseal region of the tibia was filled with one of the grafts being evaluated (iliac or biological).

To collect the platelets, we used a Haemonetics MCS+ 9000 automated cell separator and a 995-E plateletpheresis-specific kit (Haemonetics Corp.). In this system, the patient's blood was drained through a venipuncture in the antecubital fossa into a separation device under continuous centrifugation (Figure 1).

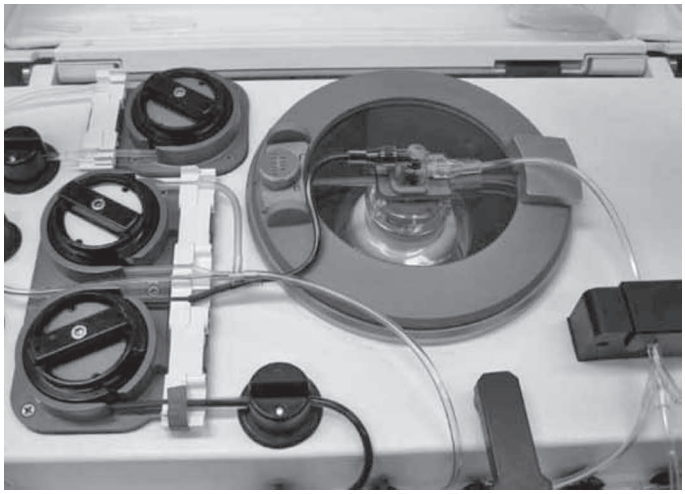


Figure 1 – Haemonetics MCS+ 9000 automated cell separator.

After blood fractionation, a refractive optical analyzer singled out the platelet layer and directed its collection into a specific disposable bag. The remaining blood was completely reinfused into the patient, marking the end of a cycle. Sodium citrate was used as an anticoagulant in a proportion of one for each 9 ml of processed whole blood. Two cycles were usually performed, yielding approximately 70 ml of platelet concentrate.

The bone marrow aspirate was obtained from the iliac crest via percutaneous puncture using the standard technique (Figure 2). Six punctures were made to obtain about 12 ml of bone marrow, not to exceed a volume of 2 ml per puncture. After each puncture, the needle was repositioned[21]. This material was anticoagulated with sodium citrate in the ratio of 1:5 citrate:bone marrow.

The biological bone graft was formed by adding the bone marrow aspirate to the platelet concentrate. Once the gel was formed, the surgeon placed the material in the surgical site (Figure 3).

For the evaluation of bleeding as a result of surgery, the RBC indices of hemoglobin (Hb) and hematocrit (Ht) were obtained[7]. These indices were obtained on the day of surgery and 24 hours postoperatively. In this manner, the variation of these indices before and after surgery was obtained. The groups were compared with respect to these variables (change in hemoglobin and hematocrit) by Student's t-test.

Pain assessment was performed using the visual analog scale for pain[22,23], performed 24 hours after surgery. The groups were compared with respect to this variable by Student's t-test.

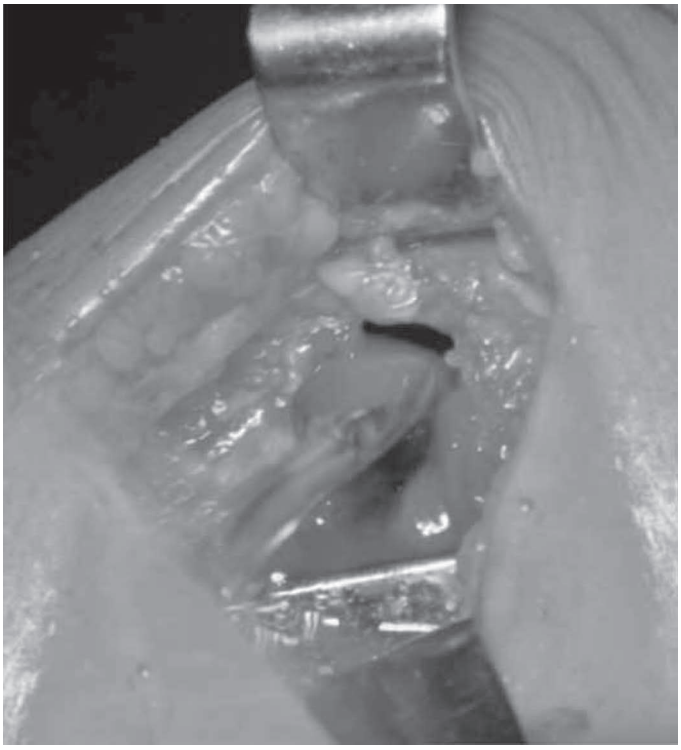
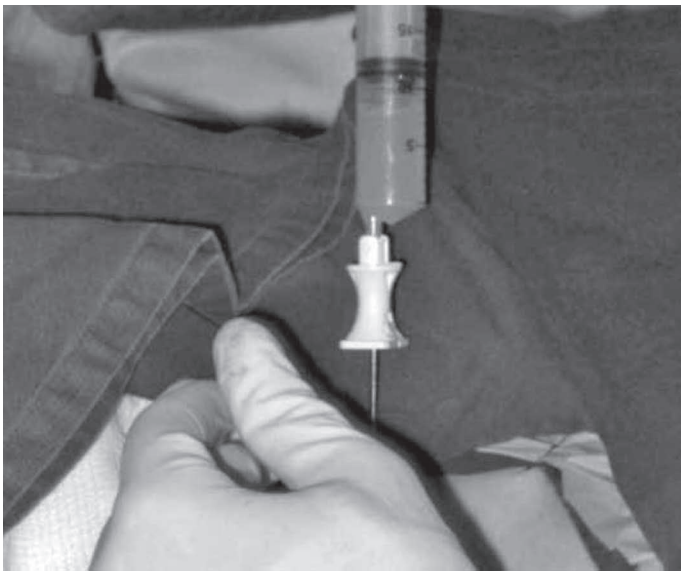


Figure 3 – Placing the biological graft at the osteotomy site.

RESULTS

There were no differences between the iliac and PRP groups in relation to the variation of levels of hemoglobin and hematocrit pre- and postoperatively (Tables 3 and 4).

Pain assessment performed using the visual analog scale for pain (VAS) was not different between groups (Table 5).



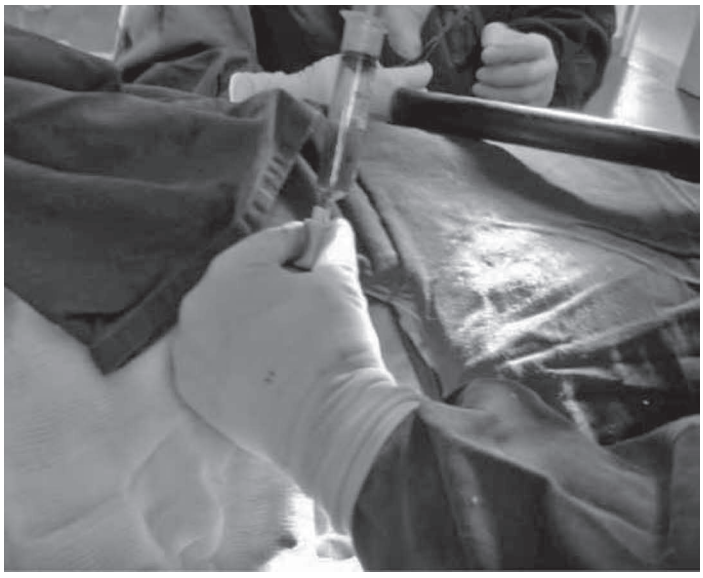


Figure 2 – Obtaining the bone marrow aspirate.

Table 3 – Changes in hemoglobin (Hb) levels.

		Iliac (n = 14)	PRP (n = 11)	Total
Difference in Hb	Mean	2.3	2.2	2.3
pre- and postoperatively	SD	1.0	0.7	0.9
p = 0.820	Median	2.4	2.1	2.2
	Minimum	-0.3	0.9	-0.3
	Maximum	3.7	3.2	3.7

P value regarding the Student's t-test.

Tabela 4 – Changes in hematocrit (Ht) levels.

		Iliac (n = 14)	PRP (n = 11)	Total
Difference in Ht	Mean	6.4	5.3	5.9
pre- and postoperatively	SD	2.3	3.1	2.7
p = 0.323	Median	5.9	5.7	5.7
	Minimum	2.3	0.3	0.3
	Maximum	10.8	9.2	10.8

P value regarding the Student's t-test.

Table 5 – Visual analog scale for pain[22].

		Iliac (n = 14)	PRP (n = 11)	Total
Pain scale	Mean	5.1	4.4	4.8
p = 0.538	SD	2.9	2.7	2.8
	Median	6.0	3.0	5.0
	Minimum	1.0	1.0	1.0
	Maximum	9.0	9.0	9.0

P value regarding the Student's t-test.

DISCUSSION

The valgus osteotomy of the tibia using the technique of adding a medial wedge is a common procedure in the treatment of several orthopedic pathologies, and today it has been thoroughly standardized[18,24-27].

Platelet-rich plasma (PRP) has important osteoinductive properties, as has been demonstrated by several experimental studies[11,28-31]. PRP has wide clinical application in the field of oral and maxillofacial surgery and is used as an osteopromotive agent in various situations[31-33]. Its clinical use in orthopedics has been increasing, despite the absence of randomized prospective studies to assess the results of its application[30,34-36].

In a study that aims to evaluate the effectiveness of PRP alone or in combination with other materials, it is important to remember that different methods are used to obtain PRP[1,5,30], and the ability to obtain high concentrations of platelets is variable among the available methods. Most systems used in clinical practice are based on centrifugation; the centrifuges used for this purpose have been developed for diagnosis and not to obtain PRP, which is often generated with less than ideal platelets level. The method of obtaining PRP used in our study[37] is able to offer a platelet concentration above 1,000,000/µl.

The need for an autologous graft in TOAMW is considered a disadvantage by many surgeons, because of the morbidity associated with obtaining the autologous graft[38,39]. Pain is a frequent complaint in patients who undergo obtainment of autologous grafting. In our study there was no difference in pain between the groups after 24 hours (p = 0.538).

PRP was used in TKA[6,7], reducing bleeding and the occurrence of arthrofibrosis. In our model of the clinical application, the proximal tibial osteotomy by addition of a medial wedge, there was no difference in bleeding between the groups with the use of PRP associated with bone marrow aspirate (p = 0.820 and p = 0.323).

CONCLUSION

The use of PRP associated with bone marrow in TOAMW showed no advantages over the use of autologous iliac bone graft with regard to pain and bleeding.

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