Original Article

Autologous Bone Marrow Plasma Injection after Arthroscopic Debridement for Elbow Tendinosis

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Abstract

Introduction: The treatment of tendinosis of elbow can be challenging, yet rewarding. Nevertheless, for the patients who failed conservative management and develop persistent recalcitrant symptoms, surgical intervention should be considered. The hypothesis of this study is iliac bone marrow plasma injection after arthroscopic debridement of degenerative tissue will bring along biological cure. Thus, it will not only reduce pain but also improve function in patients with resistant elbow tendonitis. Materials and Methods: Twenty-four patients (26 elbows) with significant persistent pain for a mean of 15 months, despite of standard rehabilitation protocol and a variety of other nonsurgical modalities were treated arthroscopically. We applied autologous iliac bone marrow plasma injection following arthroscopic debridement. This material is produced by centrifugation of iliac bone marrow blood at 1,800 rpm for 20 to 30 minutes. Patients were allowed full range of motion (ROM) exercise after 2 to 3 days. Cytokine analyses for this injective material were done. Outcome was rated by postoperative sonography, visual analog pain scores (VAS) and Mayo elbow performance scores (MEPS) at 8 weeks and 6 months follow-up. Informed consent had been obtained from the subjects, and the study protocol was approved by the ethics committee of Chosun University Hospital, Korea. Results: All patients in this study noted improvement both in their VAS and MEPS. No complication occurred in any patient. Evidence of tendon healing was observed in postoperative songraphic examination. Predominant cytokines of this study were interleukin-12 (IL-12), interferon-gamma-inducible protein-10 (IP-10) and RANTES. Conclusion: Biologic treatments in orthopaedics are just beginning to evolve. In the present investigation, the injection of iliac bone marrow plasma after arthroscopic debridement in severe elbow tendinosis demonstrated early recovery of daily activities and clear improvement.

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Introduction

Elbow tendinosis is a term used to describe a syndrome of pain involving the extensor or flexor tendon origin of the forearm musculature. It is a common problem in adults and it is called "medial" or "lateral epicondylitis" depending on the site of involvement. Although the name epicondylitis originally suggests an inflammation process, it is now thought to be caused by tendinous microtearing followed by incomplete reparative response of musculotendonous origin of extensor carpi radialis brevis (ECRB) or common flexor.[1,2]

A few conditions (5% to 10%) are surgical candidate, in spite of well organised conservative management. The operative treatment may be considered, when the patients had significant symptoms and functional loss for a long period of rehabilitation (6 to 12 months) without compensatory problems.

The operative treatments of elbow tendinosis include

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open, percutaneous or arthroscopic debridement of pathologic portion near the epicondylar origin. The long term outcome of operative treatment is reported to be good or excellent.[3] However, there is little knowledge about the healing process. For this, autologous blood or platelet rich plasma injection techniques were introduced.[4-6]

Our hypothesis is that autologous bone marrow plasma injection after arthroscopic debridement of degenerative tissue will not only reduce pain, but also achieve better functional results by improving biological healing.

Materials and Methods

Our study consisted of 26 elbows (24 patients) that were operated from August 2006 to December 2006 for medial or lateral epicondylitis and available for follow-up. All patients failed on non-operative treatment including rest, activity modification, physical therapy, steroid injection, electrical stimulation, bracing and non-steroidal anti-inflammatory medication for a mean of 15 months (range, 6 to 24). Ten patients were farmers and involved in heavy manual labor, 5 patients were involved in vigorous sport activity, 5 patients performed desk or office type of work and 4 patients were not working at the time of surgery. In all cases, patients complained of significant persistent pain that interfered with normal activities of daily living including combing hair, handling spoon and washing face.

There were 12 males and 12 females with a mean age of 48 years (range, 32 to 70). Sixteen patients had symptoms in dominant side and 2 patients had bilateral involvement. Fourteen elbows had pain on lateral epicondyle, 6 elbows on medial epicondyle and 4 elbows on both medial and lateral. None had trauma history on the site of pain.

The elbow tendinosis is diagnosed by physical examination and diagnostic imaging. Anteroposterior, lateral and both oblique projection of radiographs were checked in all cases to exclude obvious pathology of trauma or cubital tunnel osteophytes. Collateral ligament injury and neuritis were excluded by clinical or imaging studies. Sonographic scanning was used for the evaluation of tendon and ligament condition.

Inclusion criteria for surgery included severe persistent symptoms that interfered with normal daily life for at least 6 months following presentation to a consultant specialist, failure of conservative treatment including rest, physiotherapy and steroid injection, and confirmation of the diagnosis. We excluded the patients' significant intra-articular pathology, lateral collateral ligament injuries or symptomatic plica syndrome.

Prior to the operation, all patients signed a detailed informed consent form concerning injection of autologous bone marrow plasma to the site of tendinosis. The investigational review board (IRB) of the authors' hospital evaluated and approved the study.

We evaluated the patients by visual analogue scale (VAS), Mayo elbow performance scoring (MEPS) and ultrasonogram before and postoperative follow-up.

Operative Technique

Under the general anaesthesia, the standard arthroscopic procedure was performed in lateral decubitus position. The arm rested on well padded table with elbow bent at 90 degrees. Preoperatively the joint was filled up with 30 ml of saline solution using the posterior soft spot. Afterwards 30 degree 4.5 mm-arthroscopes were introduced through the standard proximal lateral and proximal medial portals for medial and lateral epicondylitis respectively. Following joint inspection, Intra-articular structures were documented and the alterations of the capsular tissue in the insertion area of the ECRB and flexor origin tendon was checked (Fig. 1).

After that, the joint capsule was removed from the intra-articular side and the insertion area of the tendon was identified again. Using a motorised shaver or radio frequency device, debridement of the degenerative tissue was performed. The tendon was separated from the proximal origin at the epicondyle. After the debridement of pathologic tissue, the obtained autologous bone marrow plasma was injected at the site of debridement and to the nearby tendon such as extensor carpi radialis longus in case of lateral epicondylitis. Mean surgical time took 10 minutes.

Bone Marrow Plasma Preparation

Bone marrow plasma was aspirated from anterior-superior iliac spine of pelvis prior to the operation into the two sets of 20 mL syringe containing 2 mL of heparin. 20 mL of bone marrow was centrifuged for approximately 15 to 30 minutes in 1800 rpm. Of the centrifuged plasma, only the clear upper layer and the buffy coat layer (Fig. 2) that contained mononuclear cell (Fig. 3) was used for injection and approximately 8 to 9 mL was obtained from each patient. Bone marrow plasma was kept in the refrigerator after the centrifugation and it was mixed with 3 mL of pucaine before injection. Another 20 mL was sent to the laboratory for evaluation of cytokines.

After a suitable interval of several minutes to allow the anaesthetic to work, the needle tip was positioned into the site where arthroscopic debridement took place. Thereafter, the blood was slowly injected into the site of tendinosis and fibril discontinuity or to the adjacent tendon. No specialised equipment was required in the procedure.

Postoperative Management

The elbow was temporarily immobilised with a splint for 2 days with permission of assisted passive motion exercise.

Two days after the surgery, slowly progressive isometric exercises were recommended, active versus resistance exercises started at the earliest after 6 weeks and vigorous exercise at 2 to 3 months.

Patients were told to continue activities of normal daily living but to avoid any activities that were likely to cause symptoms. Patients then returned 8 weeks after the surgery for clinical evaluation and ultrasound analysis.

The VAS and Mayo elbow performance score were recorded prior to the procedure, and recorded again at 8 weeks and 6 months after the operation.

Cytokine analysis of bone marrow aspirate was performed after centrifuged 1,800 rpm for 15 minutes. The cytokine analysis included quantity examination of Eotaxin, GM-CSF, interleukin(IL)-2, 3, 4, 8, 10, 12(P40), 12(P70), IP-10, MCP-1, MIP-1, RANTES, TNF-α.

Statistical Analysis

Statistical analysis of differences between pre- and postoperative evaluation was performed using the Wilcoxon signed rank test**.**

Results

In all cases, degenerative change was found in the musculo-tendinous origin. Calcific material was found in 5 patients during surgery. At 8weeks' follow-up, all patients showed improvement in pain and no patients complained of any complication including infection, neurovascular changes, tendon rupture or limitation of elbow movement. In the initial measurement, mean VAS score was 7.0 (range, 6 to 9) and after 8 weeks following the procedure the mean VAS score improved to 2.4 (range, 1 to 5). At the 6 months follow-up, the mean VAS score improved to 1.7 and all patients were satisfied with the result. In 1 patient, follow-up VAS score at 8 weeks was 5, which was improved from an initial of 7 but still substantially high. However, the patient recovered the ability to use chopsticks and wash face. The patient showed no sonographic abnormality on follow-up but was treated with short-course oral corticosteroids. The VAS score improved to 3 at 6 months follow-up in this patient. Two patients no longer had pain at rest but were unable to lift heavy objects at 8 weeks follow-up. These patients were treated with oral analgesics and at 6 months' follow-up, they were able to lift heavy objects. The Mayo elbow performance score (MEPS) at pre-procedure had a mean of 52 (range, 30 to 60), which at 8 weeks improved significantly to a mean of 84 (range, 70 to 100). The mean MEPS at 6 months follow-up was 89

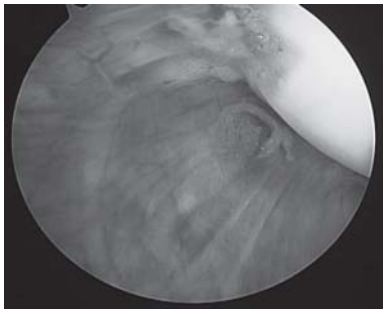

Fig. 1. Arthroscopic finding shows synovitic and degenerative tendon origin.

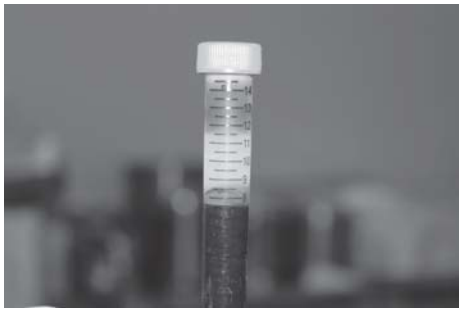

Fig. 2. Gross finding of upper plasma and the thin middle buffy coat layer of the centrifuged bone marrow blood.

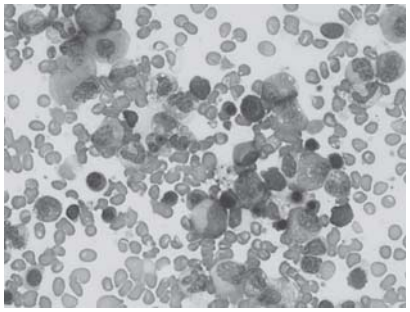

Fig. 3. Mononuclear cells are revealed in buffy coat layer (haematoxylin-eosin stain, 400x magnification)

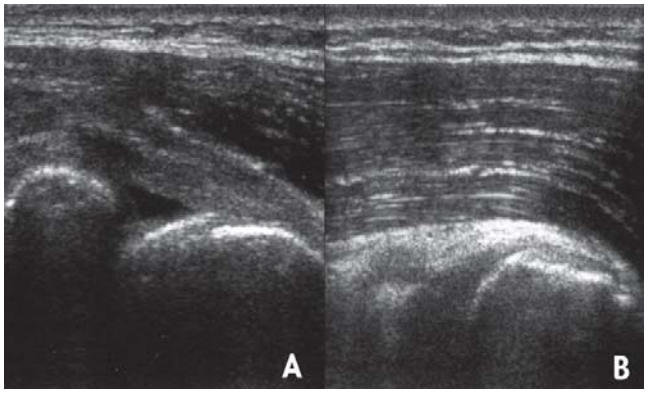

Fig. 4. Preoperative sonography of lateral epicondylitis reveals hypoechoic defect (A) and postoperative finding shows healing with uniformly arranged fibres (B).

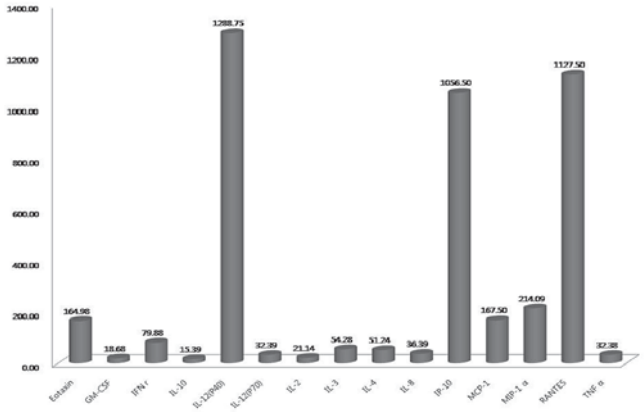

Fig. 5. Mean cytokine level (ng/mL) analysis results for bone marrow plasma at 1,820 rpm/ 30 minute of centrifugation.

Table 1. Case Profile

Case	Age (y)	Gender	MEPS		VAS score		Tendinosis
			Preop	POD 10 M	Preop	POD 10 M	
1	56	Female	60	100	8	1	Lateral
2	45	Male	60	100	7	1	Medial
3	45	Female	50	90	7	2	Lateral
4	45	Female	55	95	7	1	Medial
5	62	Female	65	100	9	1	Both
6	43	Female	40	85	7	3	Lateral
7	57	Male	30	80	7	2	Lateal
8	55	Female	50	100	7	1	Lateral
9	47	Male	60	85	6	1	Lateral
10	35	Male	55	70	6	7	Lateral
11	70	Male	50	85	7	1	Lateral
12	41	Male	50	95	6	1	Medial
13	55	Male	60	95	8	2	Lateral
14	47	Female	55	70	6	3	Lateral
15	46	Female	40	95	6	3	Medial
16	53	Female	45	90	7	2	Both
17	53	Female	45	85	6	2	Both
18	32	Female	55	85	7	1	Both
19	50	Female	55	90	6	2	Lateral
20	50	Female	50	90	7	2	Medial
21	48	Male	55	90	7	2	Lateral
22	34	Male	60	95	6	2	Lateral
23	39	Male	55	85	8	2	Lateral
24	43	Male	50	90	8	3	Lateral
25	54	Male	55	95	8	1	Lateral
26	51	Male	60	95	7	2	Lateral

*Preop: preoperative; POD: postoperative; 10M:10 months; Lateral: lateral epicondylitis; Medial: medial epicondylitis

(Table 1). The difference was found to be statistically significant (P <0.001). All patients recovered enough to conduct normal activities including combing hair, using spoons and washing faces.

Final postoperative follow-up series revealed healthy uniform orientation (Fig. 4). In cytokine analysis, significantly high levels of IL-12(P40), IP-10 and RANTES were detected (Fig. 5).

Discussion

Elbow tendinosis is a common condition seen after middle-age and is usually controlled by conservative modalities. It is thought to be secondary to degeneration of the common extensor or flexor origin. The pathology involves the origin of the ECRB in lateral epicondylitis and common flexor in medial epicondylitis.[7] These histopathological conditions reveal disrupted collagen fibres, increased cellularity and neovasculisation in the common extensor or flexor tendons.[8,9]

The study by Edwards and Calandruccio[5] showed that 22/28 patients responded to autologous blood injections, with average MEPS decreasing from 6.5 to 2.0 after a mean follow-up of 9.5 months. Their technique differed from ours in that they mixed the autologous blood with local anesthetic before injecting along the undersurface of the extensor carpi radialis brevis tendon with blind technique. Mishra and Pavelko[6] introduced bufferd platelet rich plasma technique. It may have initiated the healing process of

damaged tendons. In contrast, we injected bone marrow plasma with 0.25% bupivacain directly at the site of pathology and adjacent tissue after arthroscopic debridement. It is a targeted approach and more likely to promote biologic healing.

Cytokine and chemokine activity is essential for tendon healing and functional improvement. IP-10 is expressed in the early phase of wound healing,[10] whereas IL-12 and RANTES are produced by macrophages and dendritic cells, and may be associated with later stages.[11] We detected high levels of IL-12 p40, IP-10 and RANTES in bone marrow plasma and it may be helpful for damaged tendon healing.

In the present investigation, when the extract of the upper layer of centrifuged bone marrow plasma and buffy coat layer were used on patients, significant early improvement of pain and function was demonstrated. These results show that the small number of survived mononuclear cells and certain kinds of cytokines may be sufficient to repair degenerated tissues.

The limitations of this study include lack of a control group and the need to long-term follow-up. Although the work is still continuing, our clinical and biologic findings suggest that the use of autologous bone marrow plasma injection method provide biologic collagen healing and is an effective solution for degenerative elbow tendinosis.

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