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Platelet-rich plasma versus steroid injection for subacromial impingement syndrome

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ABSTRACT

Purpose. To compare the 6-week and 6-month outcome in 60 patients who received a single-dose injection of platelet-rich plasma (PRP) or steroid for subacromial impingement syndrome (SIS).
Methods. 22 men and 38 women (mean age, 49.7 years) opted to receive a single-dose injection of PRP (n=30) or steroid (n=30) for SIS that had not responded to conservative treatment for >3 months. The PRP or a mixture of 1 ml 40 mg methylprednisolone and 8 ml prilocaine was administered via a dorsolateral approach through the interval just beneath the dorsal acromial edge. Both groups were instructed to perform standard rotator cuff stretching and strengthening exercises for 6 weeks. The use of non-steroid anti-inflammatory drugs was prohibited. Patients were evaluated before and 6 weeks and 6 months after treatment using the Constant score, visual analogue scale (VAS) for pain, and range of motion (ROM) of the shoulder.
Results. No local or systemic complication occurred. Improvement in the Constant score and VAS for pain at week 6 and month 6 was significantly better following steroid than PRP injection. The difference in the Constant score was greater than the mean clinically important difference of 10.4. Nonetheless, the 2 groups were comparable for improvement in ROM of the shoulder.
Conclusion. Steroid injection was more effective than PRP injection for treatment of SIS in terms of the Constant score and VAS for pain at 6 weeks and 6 months.

Key words: *platelet-rich plasma; shoulder impingement syndrome; steroids*

INTRODUCTION

Subacromial impingement syndrome (SIS) is a painful condition wherein the tendinous part of the rotator cuff muscles is jammed under the coraco-acromial ligament and the antero-inferior aspect of the acromion, leading to limitation of range of motion (ROM) and loss of function.[1] It is more frequently

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encountered in persons whose work involves moving the arms above the head or in athletes in sports such as hurling, racket sports, and swimming.[2] The aetiology of SIS is multifactorial and involves intrinsic (tendinous) and extrinsic (extra-tendinous) factors. The former includes muscle weakness, overuse of the shoulder, and degenerative tendon disease, whereas the latter includes acromial morphology, glenohumeral instability, acromioclavicular joint degeneration, and thickening of the coraco-acromial ligament.[2]

According to the Neer classification,[3] stage 1 of the impingement process is characterised by acute bursitis accompanied by subacromial oedema and haemorrhage often observed among patients aged ≤25 years. Stage 2 is seen more often in patients aged 25 to 40 years and characterised by irreversible changes, and fibrosis and tendinitis of the rotator cuff. Stage 3 is seen in patients aged >40 years and is characterised by chronic changes such as partial or complete tear of the rotator cuff.

Most patients respond to conservative treatment including physical therapy, activity modification, non-steroid anti-inflammatory drugs (NSAID), and subacromial injection of steroids.[2–4] Conservative treatment reduces subacromial inflammation and pain and enables healing of the rotator cuff and functional improvement. It should be tried for at least 6 months although there is no consensus.[2]

Platelet-rich plasma (PRP) injection stimulates natural healing through growth factors in the platelets. PRP accelerates the physiological healing process, provides support for the connection of cells, reduces pain, and has an anti-inflammatory and anti-bacterial effect.[5] Obtaining PRP growth factors is simple and cheap[6]; it is autogenous, easy to prepare, and has an excellent reliability profile.[7] PRP has been used together with surgical treatment for rotator cuff repair, or with open subacromial acromioplasty for calcific tendinitis.[8–10] Different concentration systems obtain different amounts of leukocytes and growth factors in PRP.[11] PRP can also be obtained manually from peripheral blood.[12,13] The optimal volume, application frequency, application period, and platelet activation remain unknown.[14] This study compared the 6-week and 6-month outcome in 60 patients who received a single-dose injection of PRP or steroid for SIS.

MATERIALS AND METHODS

This study was approved by the ethics committee of our hospital; informed consent was obtained from each patient. 22 men and 38 women (mean age, 49.7 years) opted to receive a single-dose injection of PRP (n=30) or steroid (n=30) between November 2011 and June 2012 for SIS that had not responded to conservative treatment with NSAID and exercises for >3 months. The diagnosis of SIS was based on clinical examination (pain around the shoulder region with restricted shoulder movement, positive Neer impingement sign and/or Hawkins test) and confirmed by magnetic resonance imaging. The patients were diagnosed to have rotator cuff tendinosis (n=42) or partial tendon tear (n=18); the shape of the acromion was flat (n=38), curved (n=18), or hook (n=4).

Patients were excluded if they had frozen shoulder, acromioclavicular joint pathology, glenohumeral arthrosis, calcific tendinitis, shoulder instability, complete tear of the rotator cuff, systemic disease, pregnancy, active tumour or haematological malignancy, infection, a history of anticoagulant use, haemoglobin level <11 g/dl, thrombocyte count <150 000 mm^3, previous steroid injection to the shoulder area, or a history of shoulder fracture or surgery.

Patients were examined using the Neer impingement test.[3] Following injection of local anaesthetic (10 ml 2% lidocaine without epinephrine) into the subacromial area, the impingement test was repeated. Those who did not indicate a reduction in pain or ongoing positive impingement sign were excluded.

The PRP was prepared manually using single spin rotation.[12,13] A total of 30 cc peripheral blood was drawn from the antecubital region into tubes containing 3.2% sodium citrate. The tubes were centrifuged at 1800 rpm for 8 minutes at room temperature. From the 3.5 ml PRP, 1 ml was sent to the laboratory for bacteriological testing and platelet count; the platelet count was 4 times greater than the thrombocyte count in the peripheral blood. The 2.5 ml PRP was activated by 5.5% calcium chloride (50 μl Cl_2Ca in 1 ml PRP).

Injection of a single dose of PRP or a mixture of 1 ml 40 mg methylprednisolone and 8 ml prilocaine was administered via a dorsolateral approach through the interval just beneath the dorsal acromial edge. The patient remained in a supine position for 20 minutes following injection.

Both groups were instructed to perform standard rotator cuff stretching and strengthening exercises for 6 weeks. The use of NSAIDs was prohibited.

Patients were evaluated before and 6 weeks and 6 months after treatment using the Constant score, visual analogue scale (VAS) for pain, and ROM of

the shoulder. The Constant score comprises pain, activity level, arm positioning, strength of abduction, and passive ROM of shoulder. ROM of shoulder (flexion, abduction, internal and external rotation) was measured by goniometry.

Patient characteristics in the 2 groups were compared using the Chi-square test and Student's t-test. The changes in the mean Constant score over time between the 2 groups were compared using the Mann-Whitney *U* test. A p value of <0.05 was considered statistically significant.

RESULTS

The 2 groups were comparable in terms of age, gender, affected side, baseline Constant score, VAS for pain, and ROM of shoulder (Table 1). No local or systemic complication occurred.

In the PRP group, the mean Constant score improved from 40.9 to 43.8 at week 6 and to 52.5 at month 6. The mean VAS for pain improved from 7.5 to 5.1 at week 6 and to 5.3 at month 6. In the steroid group, the mean Constant score improved from 38.3

Table 1
Comparison of patient characteristics at baseline

	Platelet-rich plasma injection (n=30)	Steroid injection (n=30)	p Value
Mean±SD age (years)	49.2±7	50.2±2.7	0.482
No. of males:females	10:20	12:18	0.592
No. of right:left shoulder affected	16:14	19:11	0.432
Mean±SD Constant score	40.9±5.3	38.3±7.5	0.182
Mean±SD visual analogue score for pain	7.5±1.4	7.8±1.1	0.508
Mean±SD range of motion of shoulder (degree)			
Flexion	123±19	117.3±17	0.228
Abduction	92.6±12.6	90±13.9	0.447
Internal rotation	59.3±10.5	57±10.6	0.365
External rotation	55.7±9.4	57.7±8.6	0.529

Table 2
Comparison of improvement in outcome in the platelet-rich plasma (PRP) and steroid groups

Outcome	Baseline	Week 6	Month 6	Baseline to week 6	Baseline to month 6	Week 6 to month 6
Mean±SD Constant score						
PRP group	40.9±5.3	43.8±8.4	52.5±11.5	2.9±8.9	11.6±13.9	8.7±12.9
Steroid group	38.3±7.5	59.1±9.9	65.5±14	20.7±14.2	27.2±17.9	6.5±8.5
p Value	0.182	<0.001	0.001	<0.001	0.001	0.905
Mean±SD visual analogue score for pain						
PRP group	7.5±1.4	5.1±1.4	5.3±1.6	-2.4±2	-2.2±2.1	0.2±2
Steroid group	7.8±1.1	3±1.2	2.1±1.1	-4.7±1.4	-5.7±1.3	-0.9±1.6
p Value	0.508	<0.001	<0.001	<0.001	<0.001	0.01
Mean±SD range of motion of shoulder (degree)						
Flexion						
PRP group	123±19	144±13	177±7	20.6±8.7	53.6±19.9	33±13.9
Steroid group	117.3±17	142±9.2	174±7.3	24.6±11.9	57.3±18.9	32.6±12
p Value	0.228	0.431	0.106	0.219	0.482	0.97
Abduction						
PRP group	92.6±12.6	124±12.2	166±7.2	31.6±9.1	73.6±14	42±14.5
Steroid group	90±13.9	119±11.3	165±5.7	29±8	75.6±15	46.6±11.5
p Value	0.447	0.06	0.699	0.204	0.654	0.234
Internal rotation						
PRP group	59.3±10.5	69.3±9.4	80±7.4	10±4.5	20.6±5.8	10.6±4.4
Steroid group	57±10.6	68.3±8.7	82.3±5.7	11.3±3.4	25.3±8.6	14±6.7
p Value	0.365	0.522	0.205	0.218	0.023	0.024
External rotation						
PRP group	55.7±9.4	69±7.6	79.6±4.9	13.3±9.9	24±10.3	10.6±7.8
Steroid group	57.7±8.6	69.3±6.4	81.3±6.8	11.6±8.7	23.6±8.5	12±7.6
p Value	0.529	0.941	0.259	0.579	1	0.386

to 59.1 at week 6 and to 65.5 at month 6. The mean VAS for pain improved from 7.8 to 3 at week 6 and to 2.1 at month 6. Improvement in the Constant score and VAS for pain at week 6 and month 6 was significantly better following steroid than PRP injection (Table 2); the difference in the Constant score was greater than the mean clinically important difference of 10.4. Nonetheless, the 2 groups were comparable for improvement in ROM of shoulder.

DISCUSSION

PRP was first used in 1987 in heart surgery to prevent excessive blood transfusion.[15] More than 30 bioactive proteins are found within the alpha granules of platelets.[13] Growth factors (such as platelet-derived growth factor, transforming growth factor, vascular endothelial growth factor, and insulin-like growth factor) and proteins (such as fibrin, fibronectin, vitronectin, and thrombospondin) in PRP play an important role in many stages of tissue healing. The growth factors activate some of the cells in tissue healing and enable soft tissue healing and bone regeneration.[6] PRP stimulates the proliferation of various cell types in cells and tissue, and activates repair cells in the blood circulation.[16,17] It stimulates local stem cells and activates repair cells in the circulation and the bone marrow. Excessive inflammation inhibits apoptosis and metalloproteinase activity.[18] In tendon recovery, PRP increases tenocyte proliferation in the injured area by providing revascularisation by means of growth factors, and is effective in increasing collagen expression in the tenocytes.[19]

Steroid injection is active for up to 6 months and is more efficient than NSAID,[20] but it may result in complications such as skin depigmentation, fat atrophy, or tendon ruptures.

In patients with SIS, pain and limitation in ROM is common. The subacromial bursa between the acromion and the humeral head is a source of pain, as it has mechanoreceptors and a large number of pathological nerve endings that are associated with clinical symptoms.[21] The increased amount of substance-P and vascular endothelial growth factor (VEGF) in the subacromial bursa is associated with pain.[22,23] Increased VEGF is also associated with pain and synovial proliferation.[23] Level of transforming growth factor beta (TGF-β) in the subacromial bursa is higher in patients who undergo surgery for rotator cuff tears than for shoulder instability.[24] TGF-β is a cytokine that plays a key role in tissue fibrosis.[25] In our patients who received PRP injection, the lesser improvement in the Constant score and VAS for pain may be related to the VEGF and TGF-β in PRP.

A platelet count over 300 000 /μl in PRP is considered effective.[12] A platelet concentration 2.5 times greater than the basal platelet count is reported to be most effective.[26] The PRP is activated by adding bovine or human thrombin or calcium chloride.[27] Growth factors and cytokines are revealed with the formation of platelet gel from the activated PRP. The manual method of obtaining PRP costs about 10 dollars.[28,29] PRP does not pose any risk of immune reaction or disease transfer. There has been no study warning of hyperplasia, carcinogenesis, or tumour growth secondary to PRP injection.[5]

The use of PRP in pathological conditions of the shoulder has been reported.[8–10] In patients who underwent arthroscopic rotator cuff repair with or without PRP injection, both groups were comparable in terms of pain, movement angle, function scores, and recurrence of cuff tear after a mean of 19.7 months.[8] In patients with arthroscopic rotator cuff repair with PRP injection, PRP had no effect on the development of recurrent tear or on the shoulder function score.[30] In patients who underwent open subacromial decompression with PRP injection, the VAS for pain was lower, and the ROM was better.[9] In a patient with calcific tendinitis who received 3 PRP injections at 2 week intervals, the patient became asymptomatic after 6 weeks and was pain-free and had complete range of movement at one year.[10]

One limitation of this study was that it was not randomised and there was no placebo control group. The number of patients was low and the follow-up period was short. There were no radiological and biological results to correlate with the Constant score and VAS for pain.

CONCLUSION

Steroid injection was more effective than PRP injection for treatment of SIS in terms of the Constant score and VAS for pain at 6 weeks and 6 months.

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DISCLOSURE

No conflicts of interest were declared by the authors.

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