



Regeneration of Supraspinatus Tendon Following Autologous Expanded Mesenchymal Stem Cells

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Abstract

Here we present a case with a full-thickness tear of the Supraspinatus Tendon (SST) which had a dramatic clinical and radiologic response using regenerative therapy of expanded adipose-derived Mesenchymal Stem Cells (MSCs) combined with Platelet-Rich Plasma (PRP) as an alternative to surgical intervention to treat the RC tear and impingement syndrome.

Introduction

Rotator Cuff (RC) tears are relatively common pathologies; they are prevalent with ageing due to the degenerative process [1]. They can occur by or be aggravated by trauma. Many tears are asymptomatic and do not require any intervention but when they cause symptoms such as significant pain and functional impairment, medical and physical therapies are indicated to help symptoms. RC tears are less likely to heal naturally thus surgical repair is required in a good number of symptomatic cases. A subacromial steroid injection can potentially help the symptoms but often that is short-lived [2,3].

Case Presentation

A 70-year-old female presented with right shoulder pain which she had suffered from an injury in June 2018. The patient was fit and healthy apart from previously significant osteoporosis which was treated successfully with zoledronic acid infusions and currently only using monthly vitamin D tablets. A conservative treatment plan of anti-inflammatory medicines and rehabilitation were prescribed. A radiograph of the right shoulder was undertaken in September 2018 was largely unremarkable except for reduced bone density and Ultrasound Scan (USS) revealed a small partial tear of supraspinatus was discovered with subdeltoid bursa thickened to 2.8 mm resulting in a USS guided cortisone injection being administered by the radiologist to good effect. The patient however developed another shoulder injury to the same side in November 2018 with a further USS scan carried out in December 2018 which showed the previously seen small rotator cuff tears with recurrent subdeltoid bursitis with bursal impingement limiting abduction. A further USS-guided cortisone injection was given by the radiologist two days following the scan.

Her condition was stable until she developed the third right shoulder injury in April 2019 when a four-year-old child accidentally jumped on her right shoulder resulting in significant Visual Analogue Score (VAS) pain scores of 9/10. The resulting pain greatly affected her sleep and significantly restricted her abduction and flexion movements.

Despite positive input from her GP and rehabilitation team, her injury deteriorated resulting simple tasks like writing to be all but impossible. A repeat USS was performed in June 2019 and showed no improvement returning the same diagnosis of a swollen and hypoechoic Supraspinatus (SST) and identified a full thickness, fluid filled partial width tear, anteriorly measuring 9 mm length, 13 mm. The overlying bursa was swollen to 2.9 mm as shown in Figure 1.

An MRI confirmed the ultrasound findings and she was advised by the orthopedic surgeon to undergo a surgical repair of the SST and debridement of the subacromial bursa as further cortisone could increase the tear and was unlikely to resolve her condition. The patient was against surgical intervention due to post surgery complications, going under GA and lengthy post-operative rehabilitation. In her research for an alternative, she discovered a noninvasive treatment in New Zealand using adipose-derived expanded MSCs combined with PRP. Her assessment carried out in August 2019 highlighted the ongoing right shoulder antero-lateral deep sharp pain with loss of function. She used Tramadol, Amitriptyline and Panadol daily to control the pain and she held her right arm in an adduction posture to lessen the constant discomfort.

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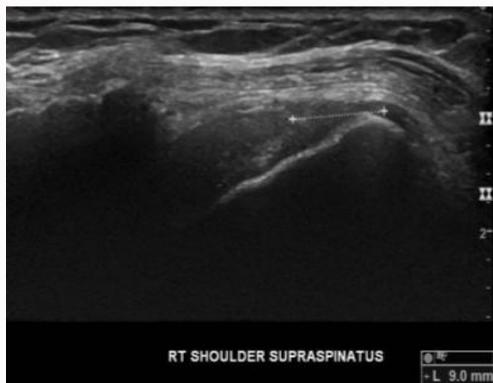


Figure 1: RT Shoulder Supraspinatus.

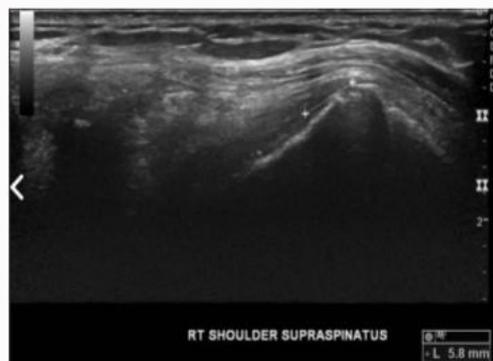


Figure 2: Bursitis has been resolved.

Physical examination revealed tender SST insertion with positive Hawkins-Kennedy and Neer tests and active right glenohumeral range of motion was; flexion 0° to 80°, abduction 0° to 60°, and both external and internal rotations 0° to 20°. The clinical picture was consistent with symptomatic full-thickness SST tear and significant impingement.

After discussing the use of regenerative therapy of expanded MSCs combined with PRP, she underwent abdominal adipose stem cell harvesting. While waiting for the stem cells to be cultured in the specialized Laboratory (lab), she had PRP injections into the SST and subacromial bursa for symptoms control which helped temporarily. The MSCs were then grown in the lab. Four weeks later, in October 2019, 100 million of MSCs combined with PRP were injected under USS guidance targeting the SST and subdeltoid bursa; this was followed by two weeks of rest and then gradual physiotherapy.

Follow ups were done through phone and email to track progress. A follow up scan performed at the same facility carried out five months post injection in March 2020, showed the supraspinatus tear still visible but it appeared approximately the same width it was shorter in length showing some healing of the tear occurring with some internal echoes now present. Bursitis has been resolved as shown in Figure 2.

In early May 2020, seven months post injection, the patient reported VAS pain score 0/10 when not overdoing exercises, all pain medications for the shoulder pathology had ceased, she had returned to activities like swimming and was able to carry out normal daily functions. The patient also recorded her sleep has been uninterrupted by pain.

Her right glenohumeral active range of motion was: Flexion 0° to

170°, abduction 0° to 160°, external rotations 0° to 70° and internal 0° to 70° suggestive of good recovery.

Discussion

Tendons are subjected to degenerative changes due a diminished regenerative capacity from reduced blood supply. Torn tendons often heal by forming scar tissue, which is structurally weaker than healthy tendon tissue, predisposing to mechanical failure. There is growing interest in providing biological stimuli to heighten the tendon reparative response. Mesenchymal Stem cells are a particularly exciting and promising science as they have high potential to provide appropriate cellular signals in order to encourage new tendon formation (neotendon) during repair rather than scar tissue. Currently, this is being studied and investigated in various research facilities and clinical practices to determine both the safety and efficacy. If successful, it will be an encouraging non-invasive option for tendon repair [4].

There are currently non-surgical options for RC tears which involve anti-inflammatory medicines, analgesics and physical therapy. For ongoing pain, steroid injections are used to reduce the inflammatory process which helps symptoms, but the effects are known to be short lived effect.

Surgical options include tendon repair and/or debridement either using arthroscopic or open approach, reconstruction and arthroplasty. While the benefits of a non-operative approach include: Avoiding surgery and its possible complications, less obvious risk factors include persisting and recurring symptoms, lack of healing process, extension of the tear, fatty infiltration, tendon retraction, atrophy of muscles and arthritis [5].

Cellular therapy is an evolving science which has been positively implicated in treating musculoskeletal conditions. It is widely accepted that mesenchymal stem cells possess multi-lineage differentiation ability and have been extensively trialed in regenerative medicine and tissue engineering [6]. Additionally, autologous MSC therapy has been demonstrated as a safe practice as detailed in many regenerative studies [7].

In summary, our case with the SST tear and subacromial bursitis has demonstrated a great clinical and radiological response to autologous expanded MSCs combined with PRP. As the cells are autologous, rejection is not an issue and combining the stem cells with PRP allows for a better outcome due to the presence of numerous growth factors in PRP. This therapy has great potential for non-surgical treatment of RC tears.

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