Chapter 1
Advancements in CT Imaging for Personalized Implants and Surgical Planning:
A Stem Cell Therapy Perspective

Rubina Ghani
https://orcid.org/0000-0003-1923-7924
Sohail University, Pakistan

ABSTRACT

The use of autologous platelet-rich plasma (PRP) and adipose-derived stem cells (ADSC) has shown therapeutic effectiveness in various conditions such as diabetic ulcers, ocular infections, cataract surgery, and dermatological disorders. This case report presents a novel approach to the treatment of cervical spinal cord injury by combining artificial intelligence (AI) with PRP and ADSC therapy. In total, the patient received two treatment sessions of PRP and ADSC therapy lasting 15 days each, while an AI – based gait, posture and deep tendon reflexes assessments were conducted before and after treatment. At baseline, hyperreflexia was noted, the patient could not stand unaided or hold himself upright; the first therapy session did not elicit any changes.

1. INTRODUCTION

Application of regenerative medicine has significantly enhanced the process of tissue repair and quickened response to injury. One of the most studied elements of

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regenerative medicine is Platelet-Rich Plasma (PRP), and it has been discovered to have immense potential for enhancing tissue regeneration. PRP is a bio-product that is extracted through plasma centrifugation and contains autologous platelets that are involved in the stimulation of cell growth, tissue repair, and healing. The regenerative potential of PRP has been widely researched, and it has been reported to induce mitosis and angiogenesis, which are critical for the repair and healing of damaged tissues. This makes PRP a potential therapeutic agent, particularly in the treatment of injuries such as spinal cord injury (Hussen et al., 2024).

Spinal cord injury, potentially leading to disastrous results, are responsible for causing feelings of loss, pain, spasm, paralysis, and urinary incontinence. Spinal cord injuries pose a large clinical challenge because the spinal cord has no spontaneous capacity for regeneration. The latest advances in regenerative medicine have focused on the use of stem cells, particularly mesenchymal stem cells (MSCs), which have been shown to promote progenitor cell proliferation and inhibit apoptosis. The past 15 years have witnessed extensive research aimed at an understanding of the regenerative potential of MSCs, especially spinal cord injury (Yu et al., 2019; Panni et al., 2019).

Among the various sources of MSCs, adipose-derived stem cells (ADSCs) are of special interest due to their superior regenerative potential, particularly in cartilage regeneration. ADSCs are derived from fat, which is relatively easy to harvest and plentiful in supply and hence are highly desired for therapeutic applications in regenerative medicine. Their ease of handling and capacity to differentiate into numerous cell types make ADSCs eligible for the repair of various injuries, such as spinal injuries (Gupta et al., 2024).

In combination with PRP, ADSCs have also delivered promising results for the repair of spinal injuries. PRP's regenerative capabilities, such as facilitating angiogenesis and cell proliferation, match the reparative capabilities of ADSCs. Together, these agents would facilitate repair of damaged spinal cord and restoration of function. Spinal cord injury treatment by autologous ADSCs and administration of PRP is a new promising approach to potential significant improvement in patient outcome and as a new platform for clinical application in regenerative medicine (Abusalah et al., 2024; Abouchenari et al., 2024).

2. LITERATURE REVIEW

Computed Tomography (CT) imaging technology has largely been responsible for precision medicine, particularly in terms of personalized implants and surgical planning. The blending of artificial intelligence (AI), 3D modeling, and high-resolution imaging technologies in CT imaging enable real-time, high-definition