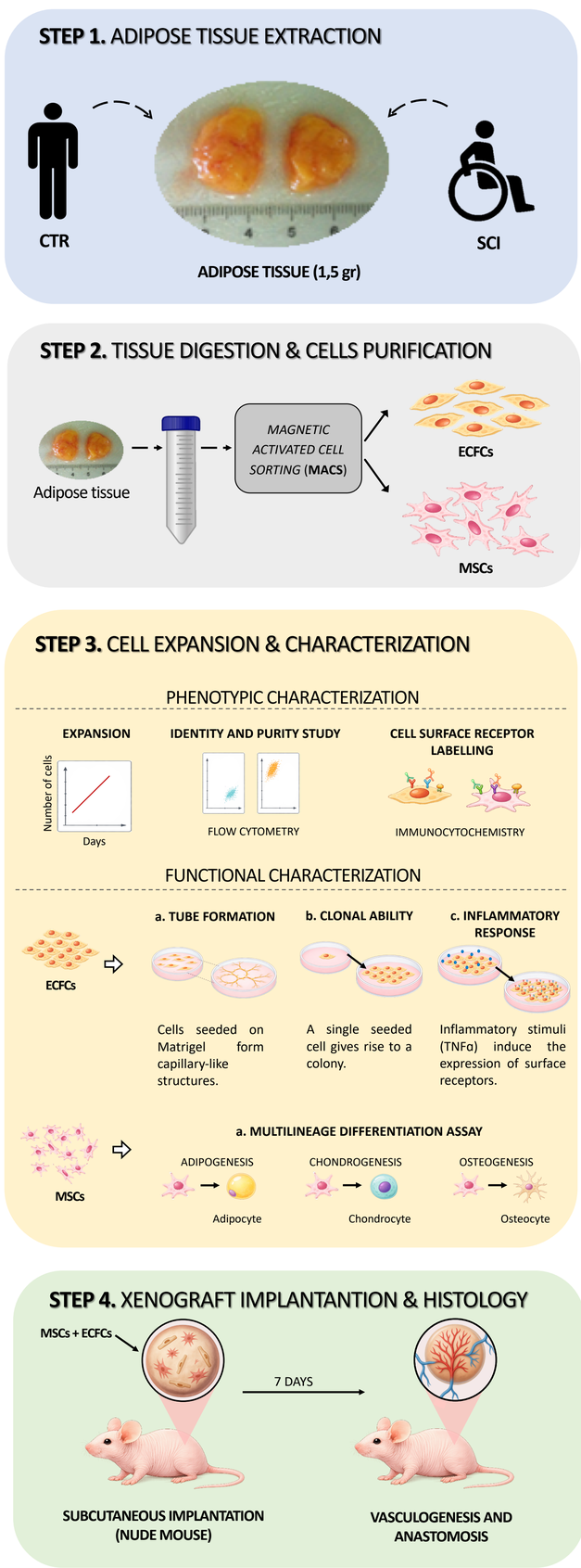
Autologous ECFC and MSC combinations from chronic spinal cord injury patients enable robust vascular regeneration

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GRAPHICAL ABSTRACT

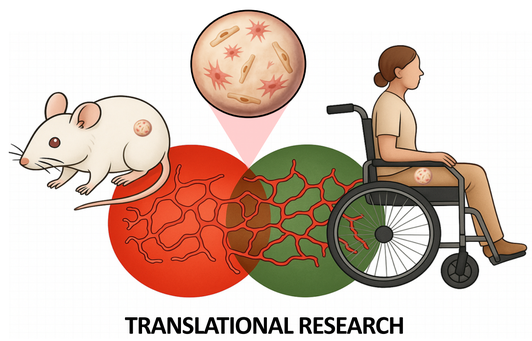


METHODOLOGY

Thirty adipose tissue (AT) samples were analyzed (15 from SCI patients and 15 from CTR). After enzymatic digestion, ECFCs ($CD31^+$) and MSCs ($CD90^+$) were **purified** and their expansion potential assessed. *In vitro*, **angiogenic capacity, clonal ability** and **inflammatory response** was evaluated in ECFCs and **multilineage differentiation** capacity in MSCs. *In vivo*, ECFC/MSC were combined in an standardized ratio and co-implanted subcutaneously in immunocompetent nude mice, and the formation of **functional perfused vessels** was evaluated after 7 days.

OBJECTIVE

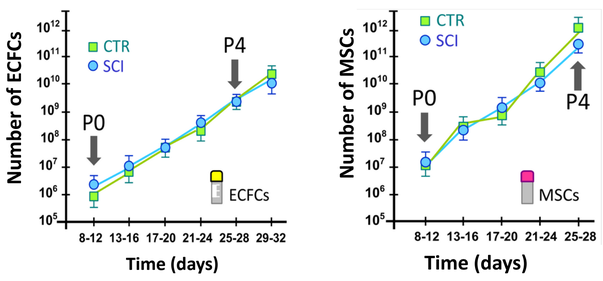
To evaluate whether mesenchymal stem cells (**MSCs**) and endothelial colony-forming cells (**ECFCs**) isolated from 1.5 g of subcutaneous adipose tissue (**AT**) from patients with chronic spinal cord injury (**SCI**) retain functional properties comparable to those of control subjects (**CTR**), and to determine their potential as a viable autologous source for revascularization strategies in regenerative medicine.



RESULTS

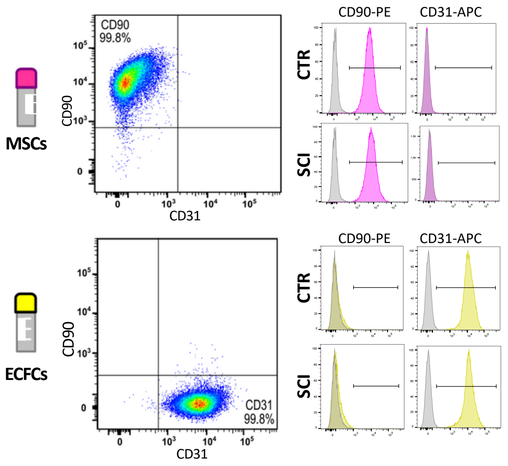
PHENOTYPIC CHARACTERIZATION

PROLIFERATIVE CAPACITY

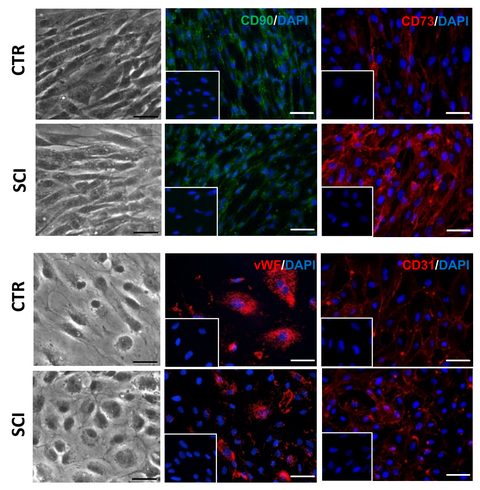


Cells isolated from SCI patients exhibited a **proliferative capacity** comparable to those obtained from CTR. Furthermore, following isolation, both cell populations displayed a **purity exceeding 99.8%** and expressed the characteristic markers **CD90/CD73 for MSCs** and **CD31/vWF for ECFCs**.

IDENTITY AND PURITY STUDY – FLOW CYTOMETRY

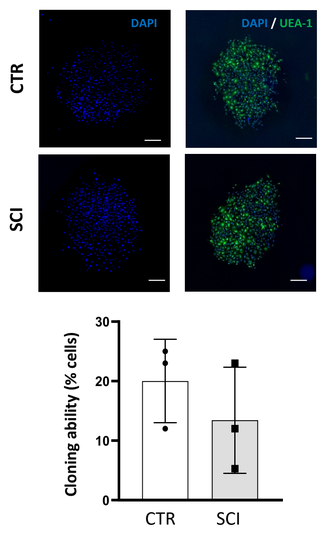


MORPHOLOGY & SURFACE RECEPTORS

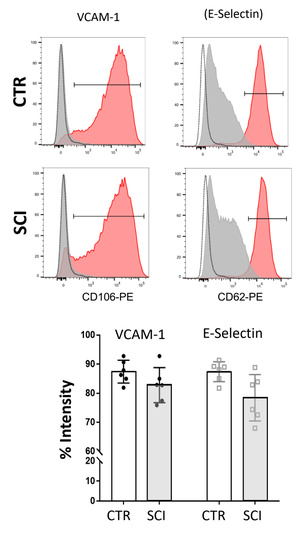


FUNCTIONAL CHARACTERIZATION

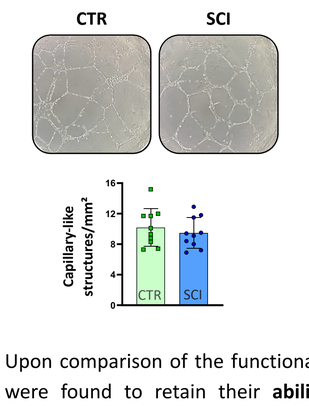
CLONAL ABILITY



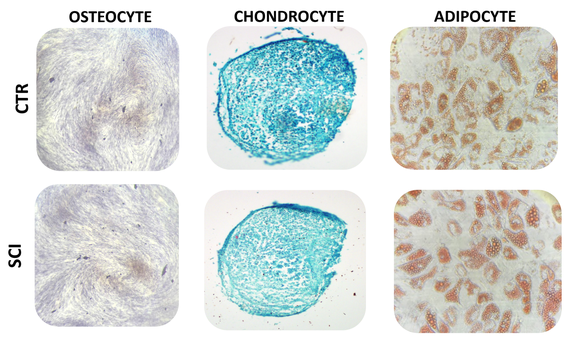
INFLAMMATORY RESPONSE



TUBE FORMATION ASSAY



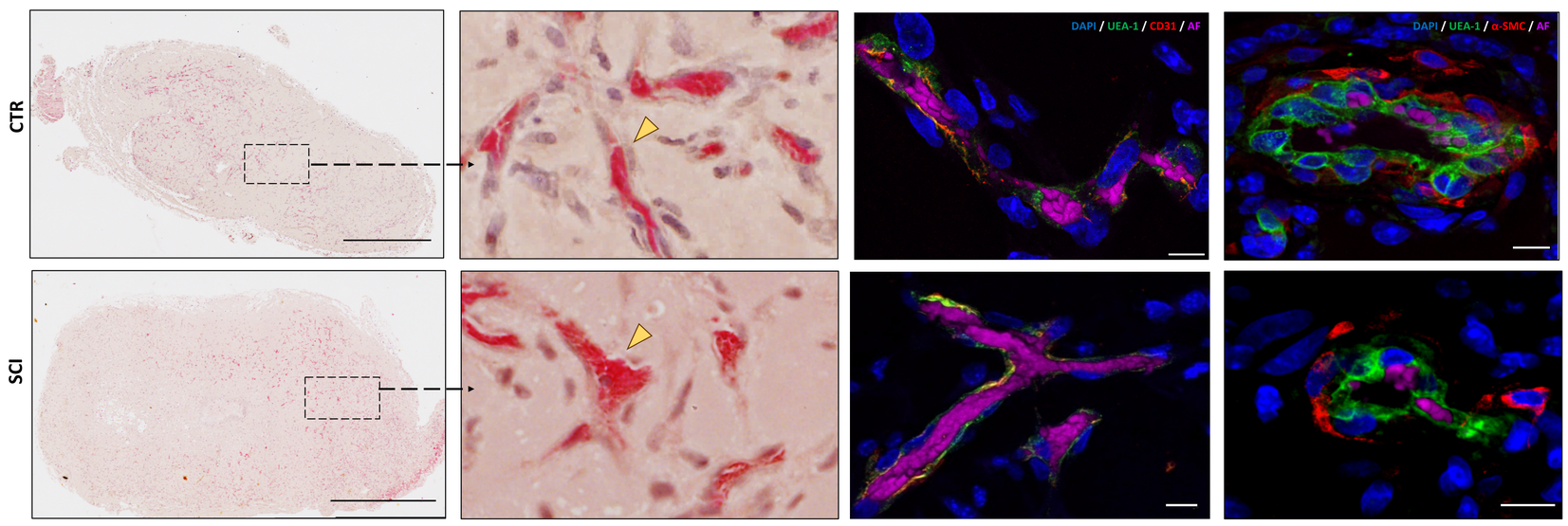
MULTILINEAGE DIFFERENTIATION ASSAY

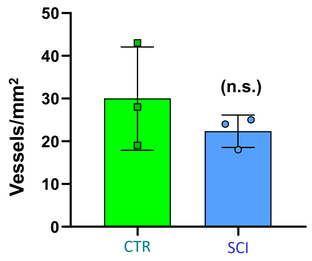


Upon comparison of the functional capacities of both cell populations, **ECFCs** isolated from SCI patients were found to retain their **ability to form colonies** from a single cell, **respond appropriately to inflammatory stimuli** and preserve their capacity **to form capillary-like structures**.

Moreover, **MSCs** derived from SCI patients **were able to differentiate into the three lineages** (adipocytes, chondrocytes, and osteocytes) with no differences compared to cells obtained from CTR subjects.

IN VIVO VASCULOGENIC POTENTIAL





Hematoxylin and eosin staining of implant sections revealed the presence of **perfused and functional vessels** within the grafts. Furthermore, no significant differences in vessel density were observed between implants containing cells derived from **SCI** patients and those from **CTR** subjects.

To determine vessel composition, immunohistochemical analysis was performed, revealing that the vessels were formed by human **ECFCs ($CD31^+$/UEA-1^+)** and **MSCs differentiated into pericytes (α-SMA^+).**

CONCLUSION

- **ECFCs** and **MSCs** can be isolated from the **adipose tissue** of patients with spinal cord injury, exhibiting **functional capacities** comparable to those of healthy controls.
- These cells are capable of **forming functional vessels** *in vivo*, highlighting their **potential as an autologous therapy** in regenerative medicine in chronic spinal cord injury patients.

FUNDING

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Reference: [1] Santos-de-la-Mata, A. (Angiogenesis, 2025).

Web: Moreno-Luna lab.

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