

Comparative Analysis of Regenerative Techniques for Treatment of Life-Threatening Injuries and Illnesses



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INTRODUCTION

- **Current Procedures:** organ transplants, skin grafts
- Skin Grafts Problem: failure rate is approximately 53.4%.¹
- Organ Transplant Problem: they do not last forever (10 years on average).²
- **Question:** what are some potential human regeneration techniques that can be used in the future to be an alternative to the current procedures?
- **Techniques in Development:**
 - Stem-cell-derived tissues
 - Human regeneration inspired by animal regeneration
 - Tissue engineering in plant scaffold

BACKGROUND

- **What can be treated with organ transplants and skin grafting?**
 - Organ Transplants: cardiomyopathy, cystic fibrosis.
 - Skin grafting: third-degree burns
- ** Regeneration aims to do the same!

BACKGROUND (Cont.)

Regeneration Techniques

Stem-Cell-Derived Tissue:

- Embryonic stem cells can grow into most types of cells in the body.³

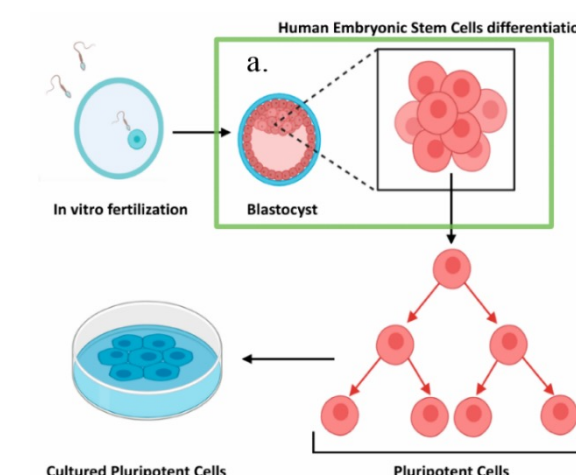


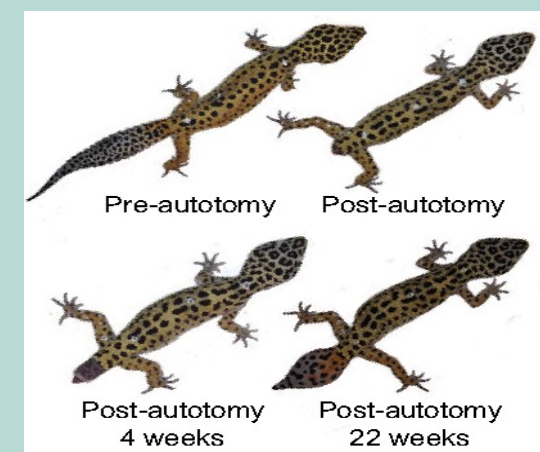
Fig. 1: Schematic representation of the extraction of embryonic stem-cells from a human embryo.⁴

- Different specializations are achieved by growth factors (eg. Hormones).³
- Shape of organ mimicked by cell matrix.³

Regeneration Inspired by Animals:

- **Human:** Injury -> scar tissue
- **Animal:** Injury -> Epidermis -> Blastema -> Regenerated tissue
- **Difference:** reptilians have a weaker immune system.⁵

Fig. 2: Stages in lizard limb regeneration post autotomy.⁶



Human Cell Infused Plant Scaffold:

- Choose the plants that mimic the vascular system of the target tissue.⁷
- **Decellularization:** plants lose all proteins and DNA after detergent soak.⁷
- **Recellularization:** human cells infused into the plant scaffold.⁷

ANALYSIS

Criteria

- Practicality: Simple to execute? Keep up with large demand? Tissue compatible?
- Animal ethics? Environmentally friendly?

Comparative Analysis

- Pros and cons of each technique:

Stem-cell-derived Tissues

- ❖ stem cells are genetically different than patients.⁸
- ❖ Patients need immunosuppressant.⁸
- ❖ Consent and embryo usage ethics.⁹
- ✓ No environmental impact.

Animal Inspired Regeneration

- ❖ Take a year to several years to regrow tissues.⁵
- ❖ Involves unethical animal testing.
- ❖ May endanger species like axolotl.
- ❖ Failure rate is high.¹⁰

Human Cell Infused Plant Scaffold

- ✓ Simple: use at home ingredients.
- ✓ Biocompatible with the human body.⁷
- ✓ Environmentally friendly.⁷
- ✓ Can be produced in high quantity.⁷

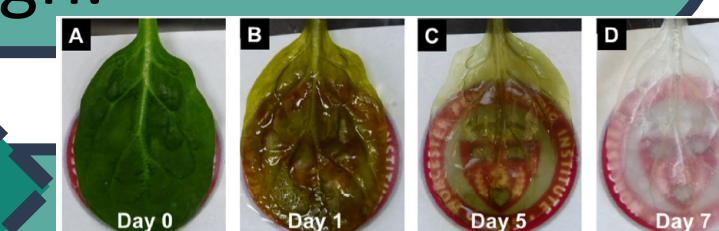


Fig. 3: Plant scaffold decellularization.⁷

CONCLUSION

- **Verdict:** Plant scaffold technique is the most doable and practical for the present.

Reasons:

- Simple technique to execute
- Can be produced in large quantity
- Environmentally friendly

Limitations:

- Based on theoretical assumptions
- No experimental results

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