## Pluripotency

In cell biology, pluripotency (from the Latin plurimus, meaning very many, and potens, meaning having power)[1] refers to a stem cell that has the potential to differentiate into any of the three germ layers: endoderm (endocrine & immune systems, gastrointestinal tract, the lungs), mesoderm (muscle, skin, bone, arteries), or ectoderm (epidermal tissues and nervous system).[2] Cell pluripotency is a continuum, ranging from the completely pluripotent cell that can form every cell of the embryo proper, e.g., embyronic stem cells.

## Multipotency

Multipotency describes progenitor cells which have the gene activation potential to differentiate into multiple, but limited cell types. For example, a multipotent blood stem cell is a hematopoietic cell — and this cell type can differentiate itself into several types of blood cell types like lymphocytes, monocytes, neutrophils, etc., but cannot differentiate into brain cells, bone cells or other non-blood cell types.

Multipotent cells are found in many, but not all human cell types. Multipotent cells have been found in adipose tissue,[3] cardiac cells,[4] bone marrow, and mesenchymal stromal cells (MSCs) which are found in the third molar.[5]

MSCs may prove to be a good, reliable source for stem cells because of the ease in collection of molars at 8–10 years of age and before adult dental calcification. MSCs can differentiate into osteoblasts, chondrocytes, and adipocytes.[6]

## Unipotency

In cell biology, a unipotent cell is the concept that one stem cell has the capacity to differentiate into only one cell type. It is currently clear that unipotent stem cells or early fetal organ cells differentiates or rejuvenates its own cell type. Hepatoblasts, which differentiate into hepatocytes (which constitute most of the liver) or cholangiocytes (epithelial cells of the bile duct), are bipotent.[29] A close synonym for unipotent cell is precursor cell or early organ/gland cell.

## Induced pluripotency

Induced pluripotent stem cells, commonly abbreviated as iPS cells or iPSCs are a type of pluripotent stem cell artificially derived from a non-pluripotent cell, typically an adult somatic cell, by inducing a "forced" expression of certain genes and transcription factors.[7] These transcription factors play a key role in determining the state of these cells and also highlights the fact that these somatic cells do preserve the same genetic information as early embryonic cells.[8] In 2007 the procedure was successful by the induction of human iPSCs derived from human dermal fibroblasts using methods similar to those used for the induction of mouse cells.[9] These induced cells exhibit similar traits to those of embryonic stem cells (ESCs) but do not require the use of embryos. Some of the similarities

between ESCs and iPSCs include pluripotency, morphology, self-renewal ability, a trait that implies that they can divide and replicate indefinitely.[10]

Due to their great similarity to ESCs, iPSCs have been of great interest to the medical and research community. iPSCs could potentially have the same therapeutic implications and applications as ESCs but without the controversial use of embryos in the process. Despite advances, iPSCs were never approved for clinical stage research in the United States. Setbacks such as low replication rates and early senescence have also been encountered when making iPSCs,[11] hindering their use as ESCs replacements.

Some of the possible medical and therapeutic uses for iPSCs derived from patients include their use in cell and tissue transplants without the risk of rejection that is commonly encountered. iPSCs can potentially replace animal models unsuitable as well as in-vitro models used for disease research.[12]

1. "Biology Online". Biology-Online.org. Retrieved 25 April 2013

2. Binder, edited by Marc D.; Hirokawa, Nobutaka; (eds.), Uwe Windhorst (2009). Encyclopedia of neuroscience ([Online-Ausg.] ed.). Berlin: Springer. ISBN 978-3540237358.

3. Tallone T, Realini C, Böhmler A et al. (April 2011). "Adult human adipose tissue contains several types of multipotent cells". J Cardiovasc Transl Res 4 (2): 200–10. doi:10.1007/s12265-011-9257-3. PMID 21327755.

4. Beltrami AP, Barlucchi L, Torella D et al. (September 2003). "Adult cardiac stem cells are multipotent and support myocardial regeneration". Cell 114 (6): 763–76. doi:10.1016/S0092-8674(03)00687-1. PMID 14505575.

5. Ohgushi H, Arima N, Taketani T (December 2011). "[Regenerative therapy using allogeneic mesenchymal stem cells]". Nippon Rinsho (in Japanese) 69 (12): 2121–7. PMID 22242308.

6. Uccelli, Antonio; Moretta, Pistoia (September 2008). "Mesenchymal stem cells in health and disease". Nature Reviews 8 (9): 726–36. doi:10.1038/nri2395. PMID 19172693.

7. Baker, Monya (2007-12-06). "Adult cells reprogrammed to pluripotency, without tumors". Nature Reports Stem Cells. doi:10.1038/stemcells.2007.124.

8. Stadtfeld, M.; Hochedlinger, K. (15 October 2010). "Induced pluripotency: history, mechanisms, and applications". Genes & Development 24 (20): 2239–2263. doi:10.1101/gad.1963910.

9. Takahashi, Kazutoshi; Tanabe, Koji; Ohnuki, Mari; Narita, Megumi; Ichisaka, Tomoko; Tomoda, Kiichiro; Yamanaka, Shinya (1 November 2007). "Induction of Pluripotent Stem Cells from Adult Human Fibroblasts by Defined Factors". Cell 131 (5): 861–872. doi:10.1016/j.cell.2007.11.019. PMID 1803

10. Liang, Gaoyang; Zhang, Yi (18 December 2012). "Embryonic stem cell and induced pluripotent stem cell: an epigenetic perspective". Cell Research 23 (1): 49–69. doi:10.1038/cr.2012.175. PMC 3541668. PMID 23247625.

11. Choi, Charles. "Cell-Off: Induced Pluripotent Stem Cells Fall Short of Potential Found in Embryonic Version". Scientific American. Retrieved 25 April 2013.

12. Park, IH; Lerou, PH; Zhao, R; Huo, H; Daley, GQ (2008). "Generation of human-induced pluripotent stem cells.". Nature protocols 3 (7): 1180–6. doi:10.1038/nprot.2008.92. PMID 18600223.