



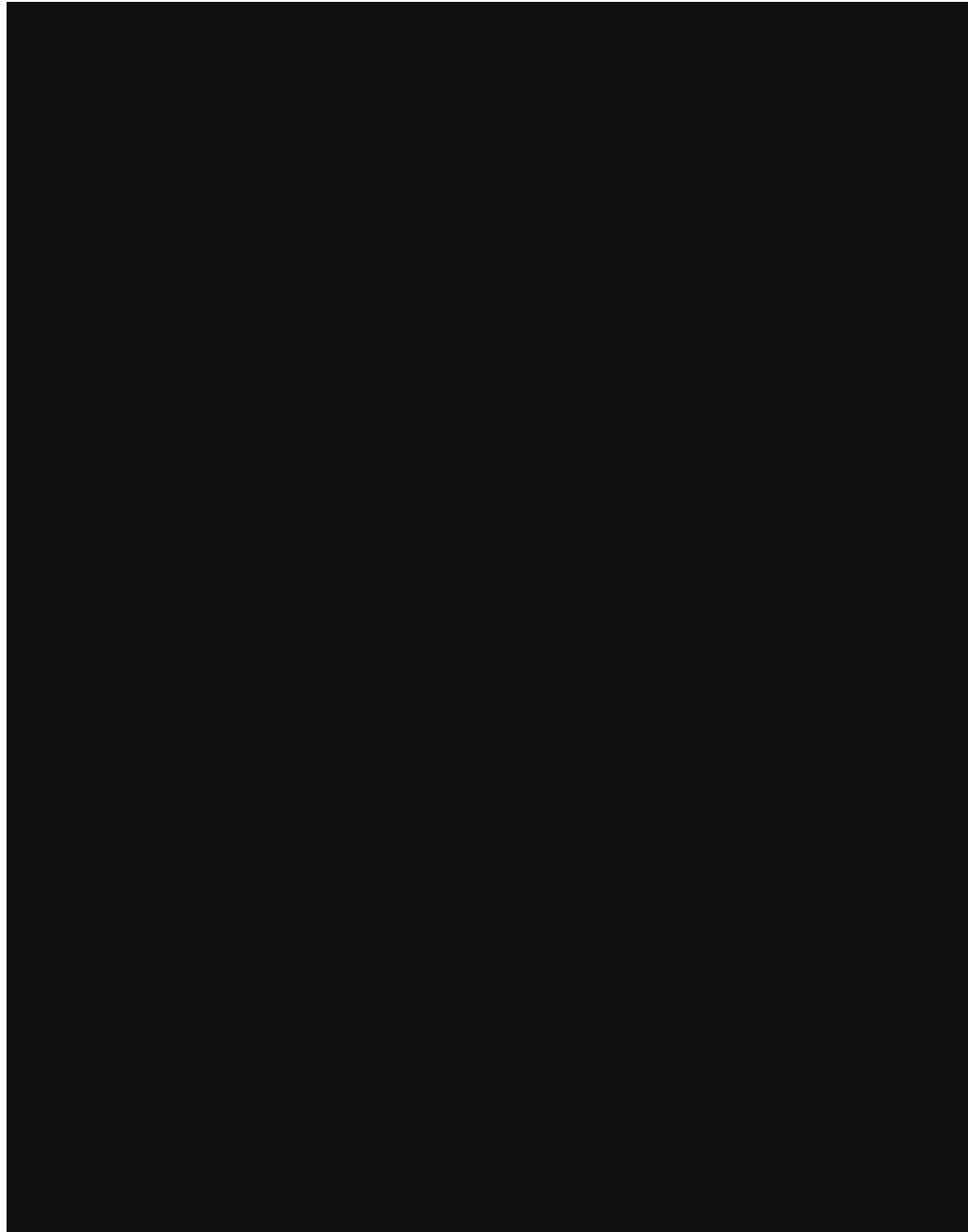
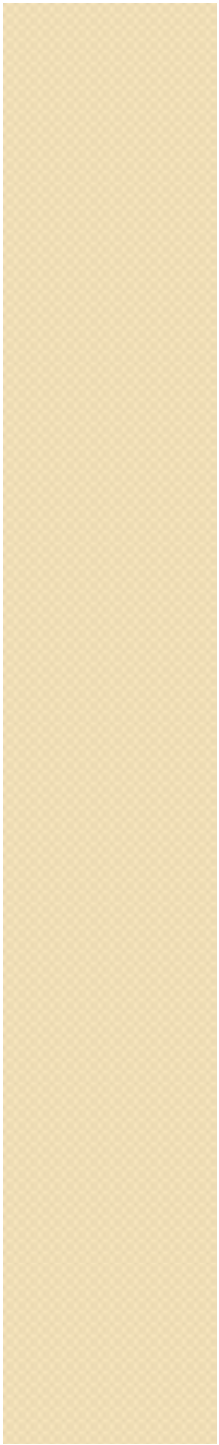
Stem Cells:  
the myth versus the reality

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# What Are Stem Cells?

- Unspecialised cells
- Stem cells have the unique ability to grow into many different cell types in the body.
- Involved in development (embryonic stem cells)
- In adult, they are found in many tissues and serve as an internal repair system
- Two important characteristics:
  - Capable of dividing and renewing themselves for long periods.
  - Can be directed to turn into specialised cells.



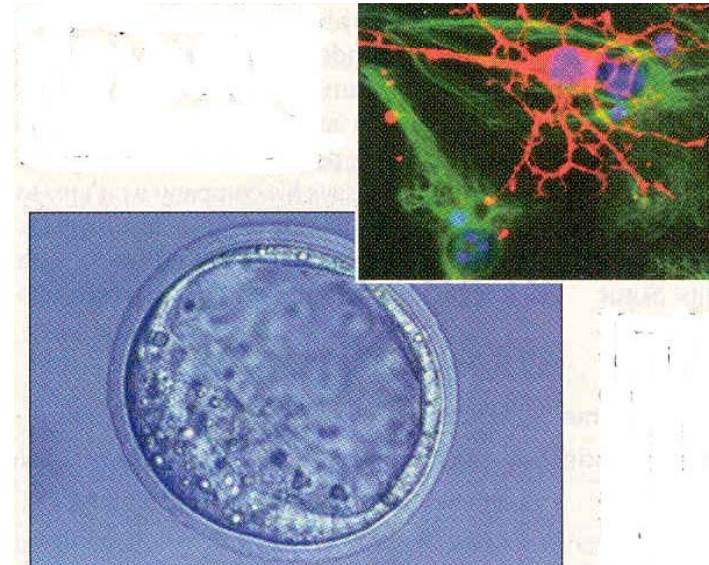


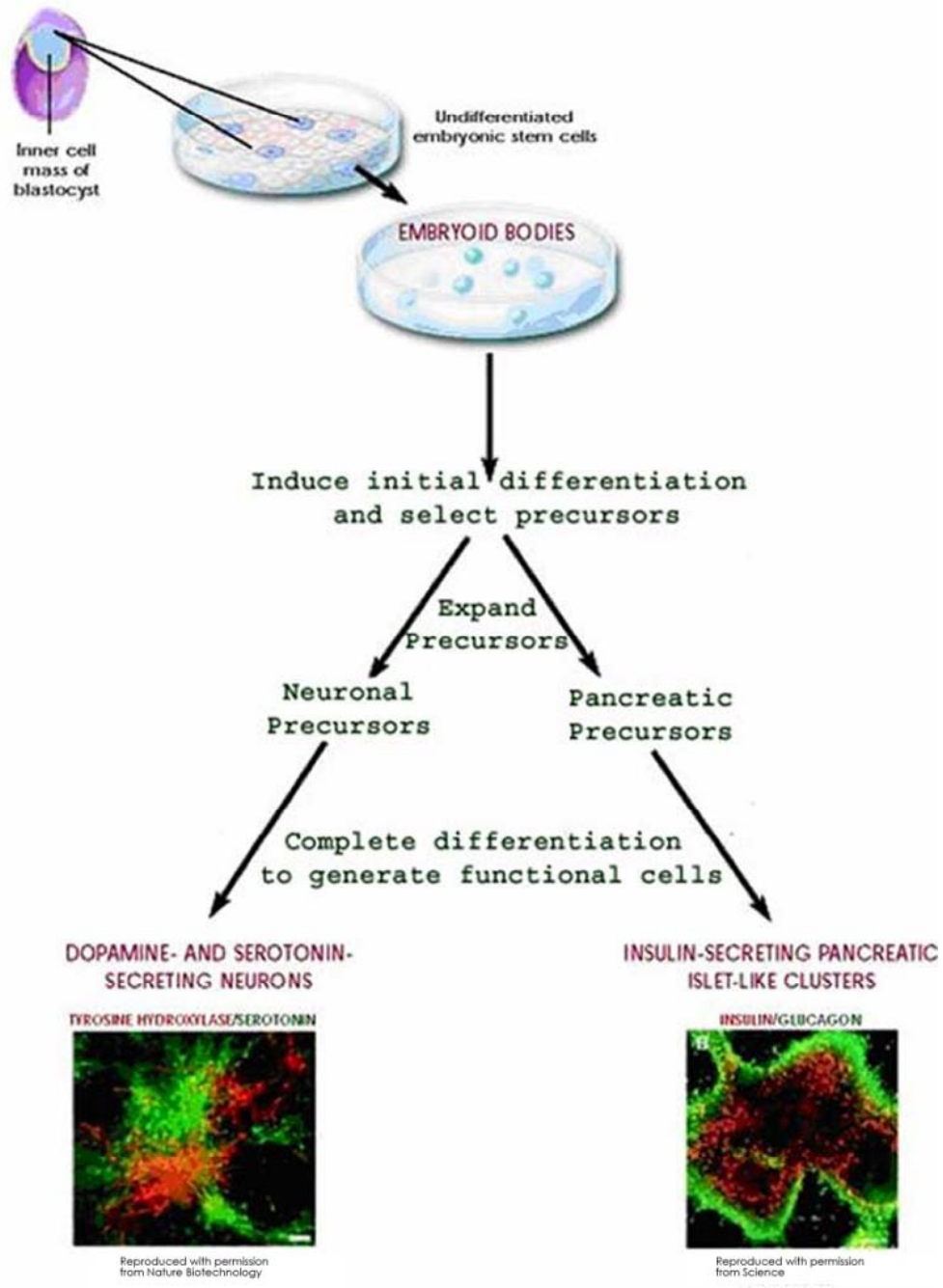
# What is Exciting About Stem Cells?

- New potentials for treating many diseases and injuries including neurological diseases and injuries.
- Provide new replacement cells for those lost through disease or injury.
- Provide supporting chemicals to enhance axon regrowth, prevent cell death and inflammation.
- Information about how brain cells develop and are affected by disease process
  - Cell models of neurological disease
- Platform for testing new drugs

# What Are Embryonic Stem Cells?

- Derived from embryos
  - Blastocyte 3-5 after fertilisation (IVF)
- Pluripotent
  - Able to generate any cell type in the body
- Can be directed by scientists to form specialized cell types = brain cells





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# What Are Adult Stem Cells?

- Uncommitted cells found among mature cells in a tissue or organ
- Can self-renew and generate the specialised cells found in mature tissue / organ
- Involved in maintenance and repair
- Exciting use in cell replacement therapy as provides potential to use patients own stem cells!

# Range of Adult Stem Cells

- Brain → neurons, astrocytes, oligodendrocytes
- Bone marrow / umbilical cord:
  - Mesenchymal stem cells → bone, cartilage, fat, connective tissue
  - Hematopoietic stem cells → blood cells

→ brain cells???

## Sources for Adult Human Stem Cells

**Brain**—It took a handful of cancer patients donating their brains to finally counter the “no new neurons” mantra that had permeated biology, despite earlier identification of neural stem cells in singing birds and rat brains. Recognition of brain marrow has changed the direction of research toward neurodegenerative diseases and spinal cord injury.

**Hair and Skin**—Stem cells in hair follicles give rise to epidermis, long known from observations on healing from burns.

**Baby Teeth**—When young Julia Shi lost a baby tooth, her dad, National Institutes of Health pediatric dental researcher Songtao Shi, spotted red material on it. When his six-year-old daughter lost another one, it went to the lab rather than under her pillow. Shi and coworkers ruptured and identified SHED—Stem cells from Human Exfoliated Deciduous teeth. “Postnatal cells from children may act totally differently than adult stem cells, and we felt the inherent difference needed to be emphasized,” Shi says of the acronym.

**Breast**—Discovered in material from cosmetic breast reduction surgery, rare stem cells are tucked into ducts, between the epithelial and contractile layers. Just one of these cells can regenerate an entire duct, or, if deranged, cause cancer.

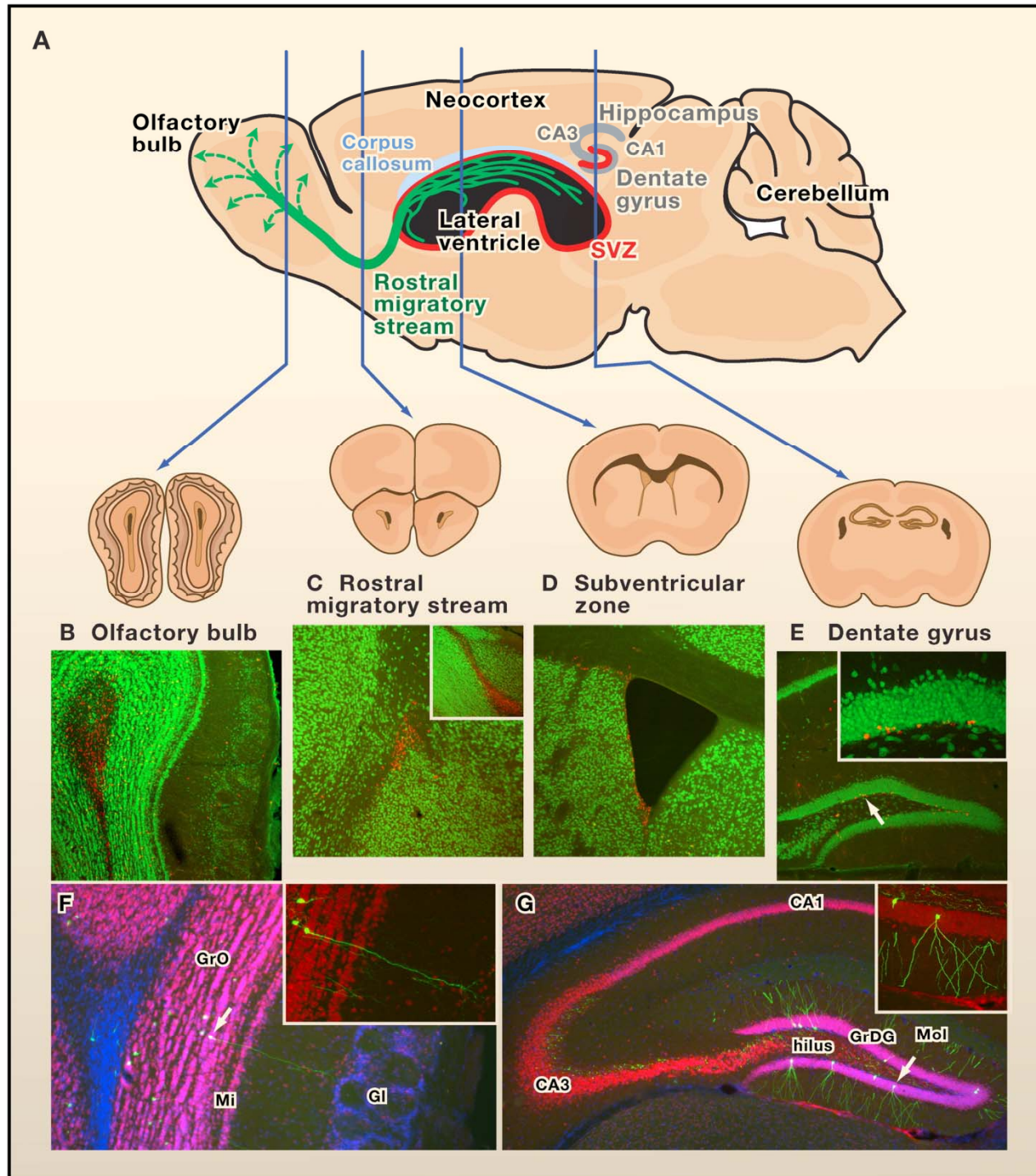
**Heart**—Place a healthy female heart into an unhealthy man’s chest, and within days, Y chromosome-bearing cells begin infiltrating the transplanted ticker. Within weeks, the new cells still bear their Y’s, but markers of “stemness” wane as antigenic badges of differentiation emerge, and the cells become heart muscle and blood vessels. Current clinical trials in Europe are testing endogenous bone marrow stem cells for use in building up heart tissue following myocardial infarction.

**Fatty Tissue**—Liposuction leftovers harbor stem cells. When plucked from a processed lipospirate, the cells differentiate in vitro into cartilage, muscle, and bone progenitors, and of course, fat. These cells are easier to obtain than similar cells from bone marrow, say University of California, Los Angeles, School of Medicine researchers, who isolated the cells in 2001.

**Bone Marrow**—Rare stem cells in bone marrow are a mother lode, capable of traveling to sites of injury and becoming neuron or muscle, lining or liver, or more. The bone marrow may be nature’s way to retain embryonic healing capacity.

**Pancreas**—Duct-lining progenitor cells in the pancreas give rise to both endocrine and exocrine tissue, say researchers at ES Cell International in Cambridge, Mass. Rather than observe development from embryonic stem (ES) cells onward, they isolated progressively less mature cell types to reconstruct the lineages. “It is overwhelming to recapitulate the whole program from an ES cell,” said ES Cells’ Diane Clarke at the recent FASEB meeting. The goal: making a little donor pancreas go a longer way to treat diabetes.

—Ricki Lewis





# What Are the Similarities and Differences Between Embryonic and Adult Stem Cells?

- Each have advantages and disadvantages for cell replacement therapy
- Embryonic stem cells can become any cell type (pluripotent)
  - but can form teratomas
- Adult stem cells limited to become cells from tissue of origin
  - don't form teratomas
- Adult stem cells rare and more difficult to grow in lab
- Embryonic stem cells grow easily but ethical issues regarding source
- Adult stem cells can be obtained from patient
  - Removes issues of rejection



# The Truth - Current Clinical Trials

- Stem cell therapy **MUST** obtain US FDA approval.
- An approved clinical treatment is a medical practice that has been shown through a formal process of clinical trials to be reasonably safe and effective for treating a particular disease or condition.
- An experimental intervention is new, untested, or different from the usual medical treatment. It has not yet been proven that it is safe or that it will work in treating the particular disease.



# The Truth - Current Clinical Trials

- A clinical trial is a research study designed to answer specific questions about a new treatment or a new way of using current treatments.
- Clinical trials are used to establish whether new treatments are safe and effective.
- It is very important to understand that the new treatment being tested is *unproven*. It may not be better than, or even as good as, existing treatments.
- Some research studies are not trials. In some cases, new experimental treatments might be tried on a very small number of people before a clinical trial is started. Again, the new treatment being tested is *unproven*.
  - Must have approval from an institutional authority / ethical approval
- The fact that a procedure is experimental does not automatically mean that it is part of a research study or clinical trial.



# The Truth - Current Clinical Trials

- Bone marrow / umbilical cord stem cells
  - Undergoing clinical trials for a range of disorders
    - Heart disease; vascular repair; bone and cartilage repair etc
  - Autologus; easily accessed; currently approved for leukemias and rare blood disorders
- Clinical trials in CNS:
  - Multiple sclerosis; motorneuron disease; stroke; cerebral palsy etc.
- Experimental intervention
  - Dr Joanne Kurtzberg Duke University
    - Cerebral palsy; Stroke
- Generate new brain cells??
  - Probably not.
  - Provide chemicals to protect cells, support regrowth of connections, stimulate resident stem cells, reduce inflammation

# The Truth - Current Clinical Trials

- Human embryonic stem cells
  - Currently only 1 approved clinical trial
    - Geron
      - Spinal cord injury - hES-derived oligodendrocytes
  - Currently on hold at start of Phase 1 to resolve issues of tumour formation.
- Olfactory ensheathing cells
  - Alan MacKay-Sims Griffith University, Brisbane
  - Phase 1/2a clinical trial
    - No significant functional improvement. No adverse effects.
  - Spinal Cord Society of NZ undertaking similar trial University of Otago



# The Myths – Stem Cell “Clinics”

- **Claims based on patient testimonials.** Clinical trials are based on extensive preclinical research or Phase I/2 clinical trial data.
- **Multiple diseases treated with the same cells.**
- **The source of the cells or how the treatment will be done is not clearly documented.** Purity of harvested cells?
- **Claims there is no risk.**
- **High cost of treatment or hidden costs.** It is not customary for someone to pay to be in a clinical trial (other than perhaps travel and other personal expenses). Consider whether you should pay for a treatment that is unproven. Furthermore, ask about the costs of emergency medical care if something goes wrong, particularly if you are outside your own country.
- **No follow-up after procedure.** No assessment of improvement. No reporting of the outcomes of the procedure to the international community.



# The Myths – Stem Cell “Pills”

- “Stimulating the release of adult stem cells from bone marrow into the circulation to slow aging process and repair areas of the body suffering from degeneration / injury.”
- ColoStem
  - Colostrum product
  - **Colostrum has no effect on bone marrow stem cell release.**
- StemEnhance®
  - Blend of two compounds extracted from the aquatic botanical Aphanizomenon flos-aquae (AFA).
  - **No scientific evidence that AFA effects bone marrow stem cell release or migration**
  - **Suggestions that chronic ingestion of AFA may cause liver toxicity.**
- These are food supplements so do not require FDA approval – be careful!



# In Conclusion

- Stem cell therapy for neurological disease and injury is an exciting possibility.
- We still have much to learn about stem cells.
- We need to be sure of the long-term safety and effectiveness of stem cell therapies before clinical use
  - Approved clinical trials are the only way to do this.
- Stem cell “clinics” do not assist with further development of stem cell therapy and many offer empty promises.
- There is no “over-the-counter” stem cell “pill”



# Supporting Information

- <http://stemcells.nih.gov/info/basics>
- [www.isscr.org](http://www.isscr.org)
  - Patient guideline to stem cell therapy
- [www.clinicaltrials.gov/ct2/info/resources/](http://www.clinicaltrials.gov/ct2/info/resources/)
- Please feel free to contact the Centre for Brain Research for support and information.