

# Next Generation Remedy For Spine

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**Abstract:** Spinal cord injury like Tetraplegia, paraplegia is serious diseases of the centre nervous system (CNS). It causes loss of nervous tissue and consequently loss of motor and sensory function. With more technology on roadways, mobs getting more prone to accidents and these kinds of injuries. The present study is about attractive strategies offered for spinal cord repair. The transplantation of SCs promotes remyelination, neurite outgrowth and axonal elongation, and activates resident or transplanted progenitor cells across the lesion cavity.

**Keywords:** Remyelination, Astrogliosis, Lesion Cavity, Buttocks, Oligodendrocyte, Neural Progenitor, Neurite

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## Introduction

A spinal cord injury is damage to the spinal cord. As we all know the spinal cord is a bundle of nerves and other tissue that the vertebrae of the spine contains and protects. The spine contains many nerves, and extends from the brain's base down the back, ending close to the buttocks. The spinal cord is responsible for sending messages from the brain to all parts of the body. It also sends messages from the body to the brain. So, if the spinal cord sustains an injury, some or all of these impulses may not be able to "get through." The result is a complete or total loss of sensation and mobility below the injury. (Morrison, 2017) A spinal cord injury closer to the neck will typically cause paralysis throughout a larger part of the body than one in the lower back area.

## Pathophysiology Of Spinal Cord Injury

### **THE PRIMARY PHASE (Mechanical)**

The primary phase involves mechanical disruption of the normal architecture of the spinal cord and is characterized by acute hemorrhage. The injury is caused by various external forces such as compression contusion or laceration. There is cumulative damage of neurons, astroglia and oligodendroglia in and around the injury disrupts circuitry and leads to neurological dysfunction, further more due to damage of blood brain barrier, the lymphocytes invade the medullar tissue and

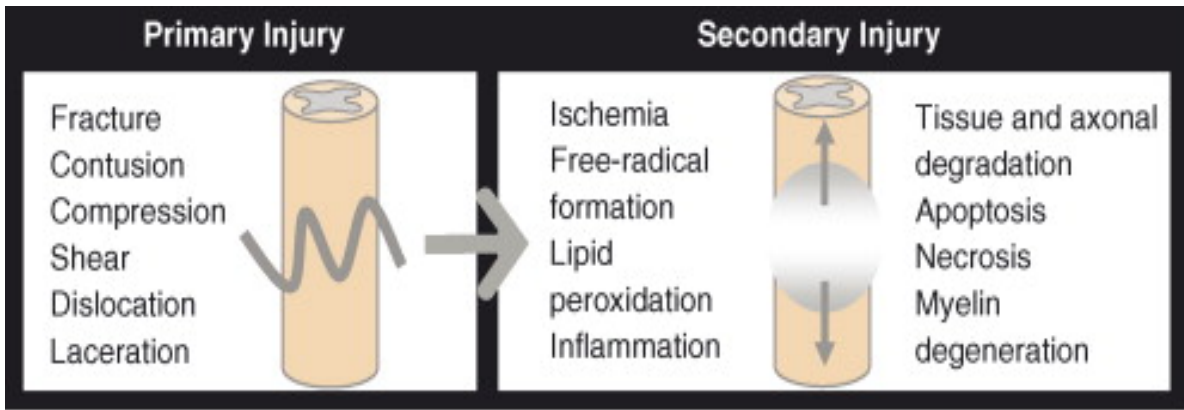
### **THE SECONDARY PHASE (Biochemical and Vascular)**

Post traumatic necrosis and apoptosis of both functional neurons and glia. Uncontrolled form of reactive **astrogliosis** that accumulate at the site of injury that is what prevents the neuron regeneration.

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*Drug Discovery Today: Disease Models*

### Potential Of Stem Cell Therapy

The stem cell therapy fulfils all the criteria for being the best therapy for epilepsy as it is enable regenerating axon to cross any cysts or cavities which functionally replaces dead cells and create an environment to support axonal regeneration and myelination .hence, stem cells have capability for remyelinating lesions.

Stem cells are capable of modifying the lesion environment, providing structural support , myelination, increasing neurotrophic factors for neuro-protection and endogenous activation. The rosette- derived progenitor cells, formed NPCS that were positive for several markers including neuron- specific class iii beta – TUBULIN (tuj1), MUSASHI, NESTIN ,C-SERIESGANGLIOSIDE ,(a2b5), MICRPOTUBULE-ASSOCIATED PROTIEN 2(map2).



**Fig: DIAGRAM SHOWING DIFFERENT LINEAGES**

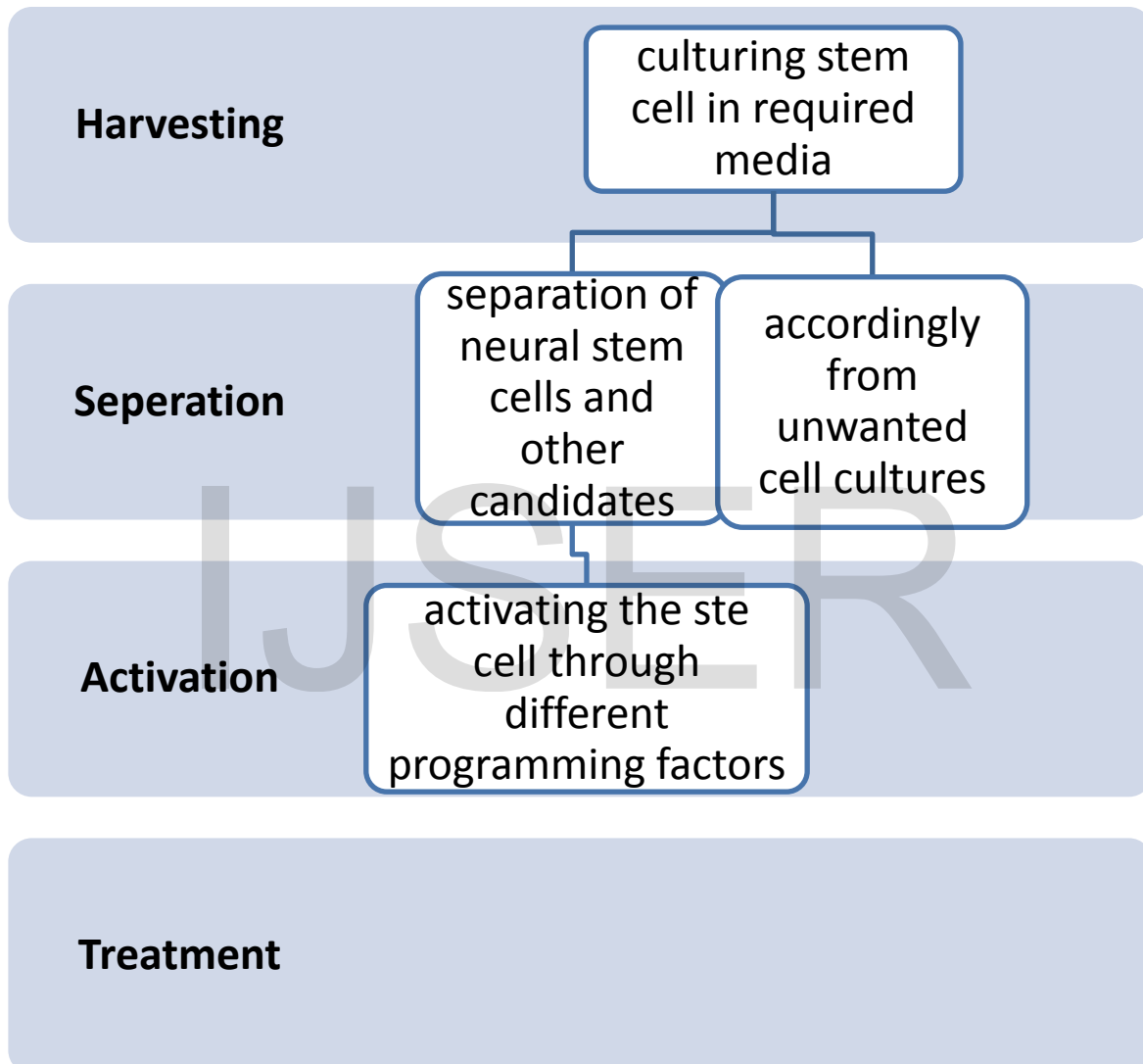
### Potential Candidates

MAJOR CANDIDATES	HUCT-Mesenchymal SC <b>(MSCs)</b>	Human umbilical cord tissue derived Mesenchymal stem cells; immune rejection is not an issue, abundant supply of Mesenchymal stem cell.
	h-ESCs derived Oligodendrocyte Progenitor <b>(OPCs)</b>	: Proved useful and reliable for the investigation of the regenerative potential.
	Neural Stem Cells <b>(NSCs)</b>	Present in the periventricular subependymal layer and subgranular zone of dentate gyrus. ,2 weeks after injury , formed mature oligodendrocytes that repaired the myelin sheath :locomotor function.
MINOR CANDIDATES	<b>(iPSCs)</b>	Formed synapses with axons, increased regeneration
	Motorneuron Progenitor <b>(MPs)</b>	After about 4 months , in the acute phase , enhanced astrogliosis: increased expression of beneficial molecule such as nerve growth factor .
	Endogenous Neural Precursor <b>(ep SPCs)</b>	Proved that it provide trophic support and positive,

## Stages Of Stem Cell Treatment

- Neural progenitor (i.e., multipotent cells from which the cells of the central nervous system arise) often aggregate into neurosphere. (Nandoe,et,al 2009)

- Cao et al, showed that neural progenitor cells transplanted into injured rat spinal favored differentiation into astrocyte.
- Human neural progenitor cells can be harvested from blastocyst stage embryos manipulated to generate functional glia.



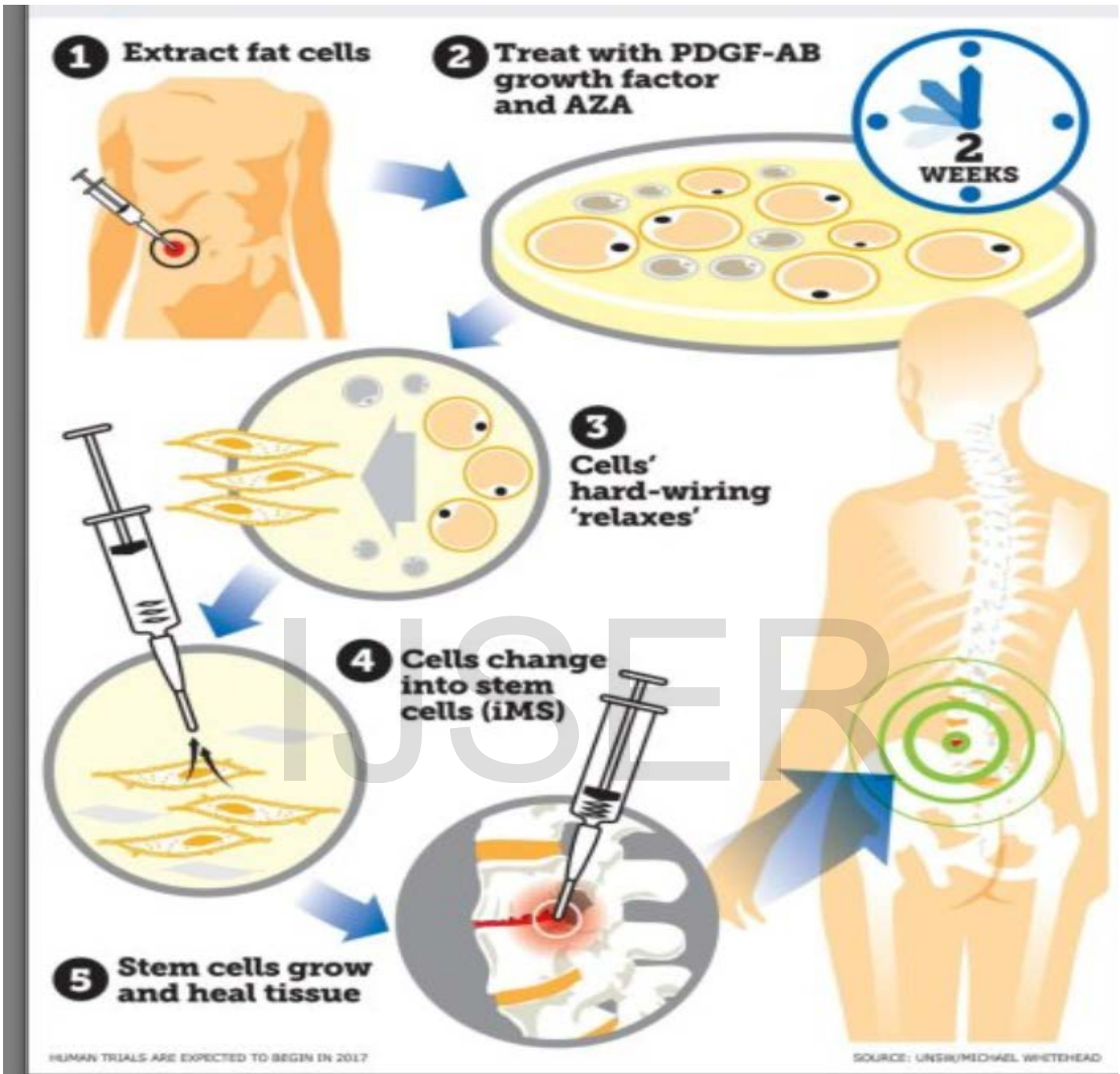


Fig : Showing different stages of stem cell therapy .

## Tracking The Way Out : Stem Cell Labeling

- **Direct Labeling**: Cells are incubated with imaging probes that enter the cells in a **transporter uptake**(eg.,<sup>18</sup>FFDG, <sup>18</sup>FFESP), **endocytosis** ( eg.,Supermagnetic iron oxide nanoparticles ; SPIO) or **passive uptake** (eg., indium-111-oxine chelate ; <sup>111</sup>In-ox).
- **Reporter Gene Labeling** : Cells can be labeled by over expression of specific reporter gene that integrate into the cellular genome via viral or non-viral vector.
- **Detection** : Signal generated from cells labeled by either technique can then be visualized using imaging systems such as magnetic resonance imaging , nuclear imaging –PET, SPECT, Fluorescence imaging , or bioluminescence imaging(BLI).

## Optimization Of Therapeutic Effect

### Administration Route And Location Of Injection

Representative methods are intravenous, intrathecal, and direct intramedullary injection.

The report on animal says that intrathecal injection are far better than intravenous injection.

For intramedullary injection , it is important to detect correct point of injection.

### Timing Of Stem Cell Transplantation

Acute phase is defined as the first three days after SCI.

Chronic phase is defined as more than 12 months after SCI.

Sub acute phase is defined as the period between acute and chronic phase.

The sub acute phase seems to be the optimal phase in respect of timing of stem cell application.

## Methodology

At **Stem cell institute, US** , the **Protocol for SCI Treatment** by Stem Cell Therapy :

- Medical evaluation , blood testing and bone marrow collection.
- **8 intrathecal** (spinal canal) injection of expanded umbilical cord tissue – derived stem cells.
- **4 intravenous** injections (IV) expanded umbilical cord tissue derived stem cells.
- **2 intravenous** injections bone marrow derived stem cells.
- **12 physical therapy sessions.**

A view to the **Protocol Of Global Stem Cells Group:**

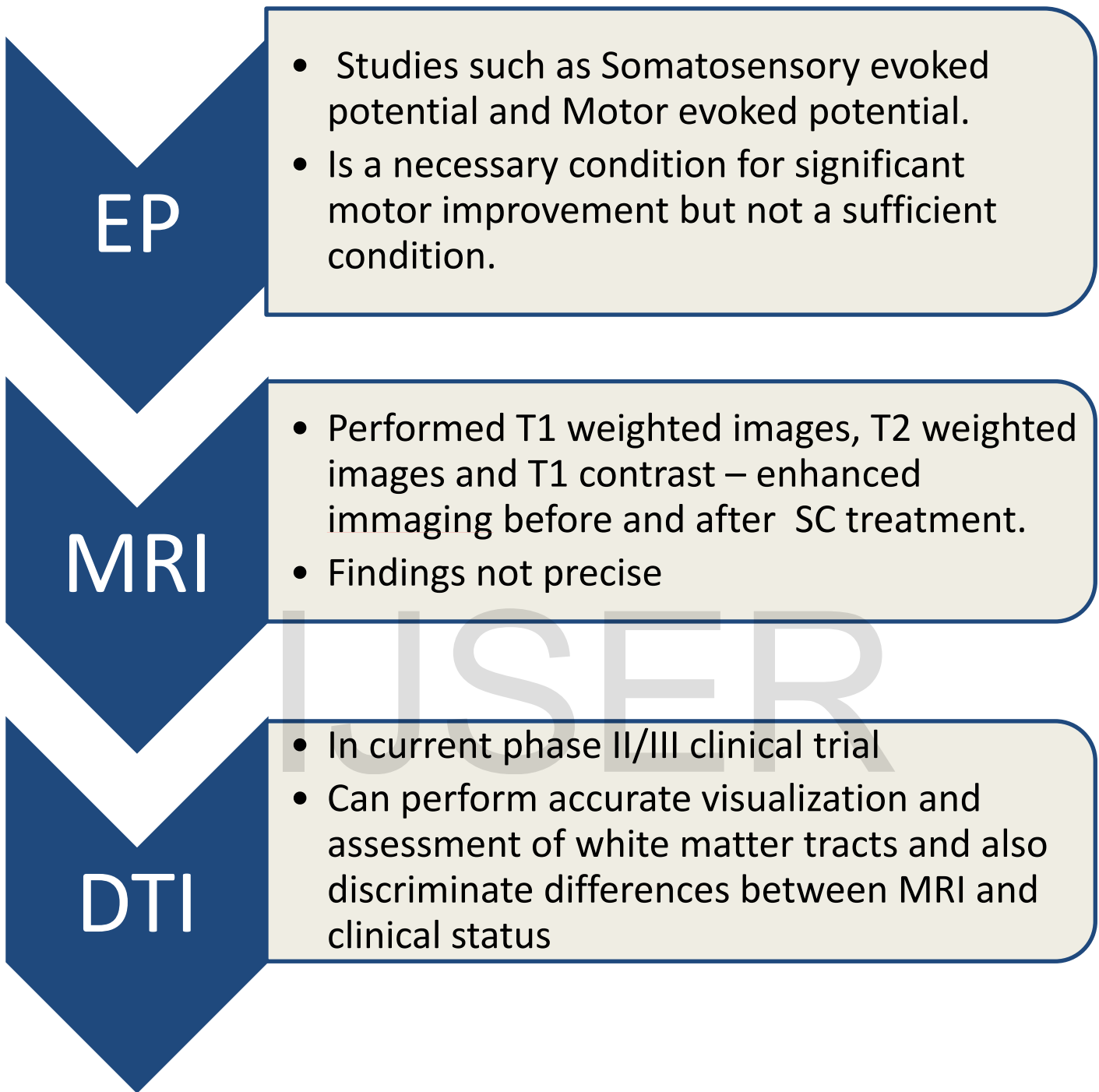
- “ We treat a few cases with Tetraplegia and paraplegia with a concentrate stem cell mix from bone marrow and adipose tissue in intrathecal application of 5 to 8 cc and rest mix is with growth factors in a intravenous solution with NaCl.”: **Mrs. Danica Goles** (Inc. Head Of Management And Marketing ,Global Stem Cells Group)
- 50% of cases showed positive results. Best results in : Spinter Control, Spasticity, Deglution , Muscular Tonicity

## Evaluation Tools of Therapeutic Effect

### Activity Of Daily Living

Daily living evaluation is the basic method for neurological recovery analysis . Various scales for evaluation are available like kartz index of independence, modified Barthel index etc.

Medical Evaluation: As shown in table below medical evaluation involves **Electrophysiological (EP) Studies, Magnetic Resonance Imaging(MRI), And Diffusion Tension Imaging (DTI).**



**Fig:** The table classifies the different diagnostic studies for epilepsy like Electrophysiological (EP) Studies, Magnetic Resonance Imaging(MRI), And Diffusion Tension Imaging (DTI).



## Conclusion

Currently there have been a numerous clinical and experimental studies showing positive results in terms of functional improvement with stem cell treatment in SCI. A lot of basic research and clinical trials has been tried using stem cell therapy and promising results have been also reported.

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