

# **Stem Cell Therapy**

Satveer Singh Shekhawat<sup>1</sup>, Parth Dashora<sup>1</sup>, Prateek Suthar<sup>1</sup>, Nayan Gupta<sup>1</sup>, Aditya Pant<sup>2</sup>, Dr. B S Sonigara<sup>3</sup>

<sup>1.</sup> B.Pharm student(BNCP) <sup>2.</sup>Asst. prof(Department of Pharmacology BNCP) <sup>3.</sup>Asst prof(Department of Chemistry BNCP)

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#### Abstract:-

The application of stem cells in regenerative and reparative therapies is emerging in surgery. A bright method for the regenerative medicines is seen in the form of stem cell therapy, and it provides different ability for the treatment of a wide range of harmful diseases, injuries, and organ failures. Stem cells have thee unique ability to grow themselves and specialized into many different kinds of cells, these cells is helpful for the regeneration of tissues and replacement or repair those cells. The different type of stem cells applied in regenerative medicines, while also their applications for treatment, problems, upcoming challenges, current scenario of stem cells, and upcoming development get investigated at this brief overview.

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#### I. Introduction:-

Stem cells are known as regenerative medicines. Stem cell therapy is used to treat damaged stem cells and it helps to repair those cells into the body. In 2024 only FDA pass approval for this therapy using the stem cell treatment. It has hematopoietic stem cell transplantation.(1)

Stem cell therapy is that type of therapy which can replace or regenerate the disease or the organ which was affected by various diseases. The country has a growing number of specialized stem cell centre and research institutions are opened that conduct the potential and future of stem cell therapy in India. Government regulations and guidelines govern the ethical and safe use of stem cells for therapeutic purposes. Now in India stem cell therapy is available at lower cost of treatment compared to other western countries.(2)

Like other developing countries, India's biotechnology research development is also developed quickly. In India many hospitals and biotechnology companies are showing their efforts in the stem cell research and development. The Clinical Trials Registry of India (CTRI) reveals 29 stem cell based clinical trials (as of November 19, 2012). The increase number of developing countries, including India, China, Brazil, and other developing countries are becoming the global hot spots for the development of regenerative medicines, including the stem cell based therapies.(3)

Stem cell can build every tissue in the human body, and it has great potential for future therapeutic uses in tissue regeneration and repair. Stem cell has the potential to produce self renewal progeny exactly the same as the originating cells. This trait is also true of cancer cells that divide in an uncontrolled manner whereas stem cell divided is highly regulated. They must be able to give rise to specialized cell type that becomes part of the healthy animal.(4) Regenerative medicine is an emerging and rapidly evolving field of research and therapeutics. Daar and Greenwood (2007) stated that regenerative medicine aims at 'repair, replacement or regeneration of cells, tissue or organs to restore impaired function'. It aids the body to form new functional tissue to replace lost or defective tissue. Ultimately, this will help to provide therapeutic treatment for conditions where current therapies are inadequate. The human body has an endogenous system of regeneration and repair through stem cells, where stem cells can be found almost in every type of tissue. This process is highly evolved through evolution, and so it is logical that restoration of function is best accomplished by these cells.(5-7)

#### Stem cell therapy for COVID-19:-

The USFDA has approved clinical trials using MSC based therapy to treat COVID-19.(2) The significant reversal of severe COVID-19 symptoms even in critical conditions was testified in two clinical studies which was conducted in China.COVID-19 triggers an overstated immune reaction in the body by producing huge quantities of numerous inflammatory factors including numerous cytokines, chemokines and immune reactive cells.(8)



#### Types of stem cells:-

- 1. Embryonic stem cells (ESCs)
- 2. Adult stem cells (ASCs)
- 3. Induced pluripotent stem cells (iPSCs)

#### Embryonic stem cells (ESCs) :-

For the first time in 1998, Thomson isolated human ESCs (hESCs). Embryonic stem cells are pluripotent in their nature and can give rise to more than 200 types of and it has the ability to treat any kind of disease.(9) Additionally, ESCs have a notably high self-renewal capacity, which contributes to their sustained presence and functionality over extended periods.(10) Embryonic stem cells are derived from the inner cell mass of the blastocyst. These cells express several transcription factors that ensure the suppression of genes that lead to differentiation and the maintenance of the pluripotency, including Oct.-4, Nanog, and Sox2(11).

#### Adult stem cells (ASCs) :-

Adult stem cells are also called as somatic stem cells. They are undifferentiated cells that are found in many different tissues throughout the body of the nearby all organisms, including humans. Scientists discovered adult stem cells in bone marrow more than 50 years ago. These blood forming stem cells have been used in the transplants for the patients with leukaemia and several other diseases for decade(12). Adult stem cells are found in most of the parts of body, including brain, bone marrow, blood vessels, skin, teeth, and heart. There are4 typically a small number of stem cells in each tissues. Due to their small numbers and ratio of division (growth), it is difficult to grow adult stem cells in large numbers(13).

#### Induced pluripotent stem cells :-

Induced pluripotent stem cells are the cells which taken from the patient that are reprogrammed so that they can undergo the differentiation into any type of cell in the body. Maintaining the genetic code of the patient, iPS cells play a crucial role in disease modelling and the regenerative medicine(14). The induced pluripotent stem cell technology has transformed in vitro research and it holds great promise to advance regenerative medicine these stem cell have been widely applied to model human development and diseases, perform drug screening, and develop cell therapies(15). The breakthrough discovery of iPS cells allow researchers to obtain pluripotent stem cells without the controversial use of embryos, providing a novel and powerful method to "DE-differentiate" cells whose developmental fates had been traditionally assumed to be determined. The tissues which derived from the iPS cells will be a nearly identical match to the cell donor, which is an important factor in the research of the disease modelling and the drug screening. It is expected that iPS cells will help researchers learn how to reprogram cells to repair damaged tissues in the human body(16).

#### Current scenario of stem cell therapy :-

Recent studies showing the successful use of stem cell therapies to patients have increased optimisms that these regenerative techniques could eventually be used to treat a variety of difficult illnesses. Stem cell based therapies face many obstacles that need to be urgently addressed. The most persistent concern in the ethical conflict regarding the use of ESCs. As i mentioned previously that ESCs are far superior regarding their potency; however, their derivation require destruction human embryos. The discovery of iPSCs overcame this concern: nevertheless, iPSCs themselves currently face another ethical controversy of their own which addresses their unlimited capacity of differentiation with concern that these cells could one day be applied in human cloning. The use of iPSCs in therapy is still considered a high risk treatment modality, since the transplantation of these cells could induce the tumour formation. Such challenges is currently addressed through developing optimized protocols to ensure their safety in addition to developing global clinical grade iPSCs cell lines before these cells are available for clinical use. Finally it could be postulated that one of the most challenging ethical issues faced in the field of stem cell based therapies at the moment is the increasing number of clinics offering unproven stem cell based treatments. Researchers are thus morally obligated to ensure that ethical consideration are not undermined in pursuit of progress in clinical transplantation.(9,10,17–19)

Stem peucel, the India's first allogenic cell therapy product, was approved for commercial use worldwide in 2020. The APCeden and ossron, RM products are currently being utilized to treat cancer and bone abnormalities. Pandorum Technologies , an RM company in India, has secured impressive funding of 41 crore rupees for the stem cell technology research. In addition Stem Cures invest \$54M to build India's largest stem cell laboratory in Telangana, establishing India as a global leader in stem cell research. With the notable developments,



India is on its way to becoming a global leader in stem cell research and therapy(SCRT). Stem cell regulations in India faces challenges due to the absence of specific legislation which can be exploited by unscrupulous practitioners. The Ministry of health and family welfare, Government of India amended the drugs and cosmetics rules 1945 in 2018, defining SCCPs as drug obtained processed cells through substantial from manipulation. Anyway this definition excludes minimally manipulated stem cells creating a regulatory loophole. ICMR disagreed with a proposed amendment that would exempt minimally manipulated stem cells from classification as drugs, arguing it could contravene the principles outlined in the NGSCR 2017. The imprecise definition of SCCPs is causing a regulatory vacuum in the enforcement of SCT in India.

Direct to consumer advertising in the field of SCT has led to exaggerated expectation regarding the availability and effectiveness of such treatments, positioning India as one of the leading countries in the international stem cell tourism market. Despite existing regulation such as NGSCR 2017 the drug and magical remedies act of 1954, and recommendations from the ICMR, clinics, and hospitals continue to disseminate misleading marketing materials for purported drugs drugs and magical cures which is expressly prohibited.(5,20– 22)

Since stem cell fundamental research has grown so quickly in recent years the relatively young field of "transnational research" has developed dramatically, drawing on the findings of basic research to create new treatments. Once the necessary regulatory clearances have been obtained, the clinical translation pathway begins. Translation research is crucial because it act as a filter to make sure that only safe and efficient treatments make it to the clinic. It fills the space between the bench and the bed. Skin graft for severe burns and bone marrow transplant of the haematopoetic stem cells are the two main stem cell based treatment that use adult stem cells that are currently clinically available.(6,20,23,24)

# Some diseases which treated by stem cell therapy :-

**Cardiovascular diseases :-** Despite the availability of pharmacologic therapies for cardiac diseases both in the US and globally, morbidity and mortality from this class of pathologies are still highly prevalent, with coronary heart disease as the leading cause (41.2%) of deaths attributable to cardiovascular disease, followed by stroke (17.3%), other cardiovascular diseases (16.8%), hypertension (12.9%), heart failure (9.2%), and disease pathology involving the arteries (2.6%). This points to the need to look for other therapeutic options. Given this unmet need with present pharmacologic methods, stem cell therapy has been explored in recent years as a potential treatment for numerous diseases. Stem cells are defined as multipotent cells, which are able to develop into any end-organ tissue cells, renew themselves, and reside inside the body without eliciting an immune response (immunoprivileged). In cardiac diseases specifically, many studies have explored the use of numerous stem cell types in ischemic heart disease (IHD), congenital heart disease (CHD), and dilated cardiomyopathy (DCM), where current treatment method are either non-curative, costly, or limited.

Congestive heart failure is when the heart cannot pump blood effectively, leading to fluid buildup in the lungs and other parts of the body. Stem cell therapy has been investigated as a potential treatment for congestive and heart failure patients. Stem cell can differentiate into various types of cells, including heart cells. Studies have shown that the stem cells can improve the heart function in patient with congestive heart failure. Stem cells have been shown to stimulate the growth of new blood vessels and heart muscle cells, thereby improving cardiac function and blood flow and reducing inflammation in the heart.

IHD is the result of arteriosclerosis progressively reducing coronary flow and thus oxygenation of cardiac tissue, causing left ventricular cell death and dysfunction. The regenerative properties of stem cells have been harnessed as potential IHD therapies give that current treatments simply manage symptoms without repairing damage to the heart.(25–29)

Neurological disorders :- Parkinson's disease is characterized by the progressive loss of dopaminergic neurons in the substantia nigra, leading to motor and non-motor symptoms. Stem cell therapy for parkinkson's has shown promising results in preclinical and early clinical trials, with stem cells differentiating into dopamine-producingneurons and alleviating some symptoms. Stem cell can potentially replace the therapy lost dopaminergic neurons by transplanting stem cells that differentiate into dopaminergic neurons, restoring dopamine production and alleviating symptoms. The use of fetal-derived neural stem cells has shown significant promise in rodent models of Parkinson's disease, and the potential for



tumorigenicity appears to be minimal. The authors report that undifferentiated human neural stem cells (hNSCs) transplanted into severely Parkinsonism 1methyl-4-phenyl-1,2,3,6-tetrahydropyridine

(MPTP)-treated primates could survive, migrate, and induce behavioral recovery of Parkinsonian symptoms, which were directly related to reduced dopamine levels in the nigrostriatal system. Working with these cells, the researchers created dopamine neurons deficient in DJ-1, a gene mutated in an inherited form of Parkinson's. They report that DJ-1-deficient cells -- and especially DJ-1-deficient dopamine neurons -- display heightened sensitivity to oxidative stress, caused by products of oxygen metabolism that react with and damage cellular components like proteins and DNA. In a second paper, they link DJ-1 dysfunction to the aggregation of alpha-synuclein, a hallmark of Parkinson's neuropathology.(30–32)

Bone and joint disorder:-Osteoarthritis is a degenerative joint disease that affects millions of people worldwide and causes pain, stiffness, and decreased mobility. Conventional treatment involves medication, physical therapy, and surgery; all of these have significant side effects and provide minimal relief. With potential benefits beyond symptom relief, stem cell therapy has emerged as a competitive adjunctive treatment for osteoarthritis in recent years. The best healthcare provider, Stem Cell Care India, offers the best stem cell treatment for osteoarthritis disease in India. There's a state-ofthe-art procedure that has shown some success in the management and healing of joint pain and injuries to soft tissue. Stem cell therapy involves taking healthy stem cells, either your own or those from a donor, and injecting them directly into the afflicted area. The stem cells then regenerate, adapting to the specific need for which they are intended. The cells regrow healthy tissue or bone to allow your joint to heal

A retrospective cross-sectional study analyzed data from patients who underwent stem cell therapy for osteoarthritis or bone defects between January and September 2023. Outcome measures focused on pain and function improvements using tools such as Visual Analog Scale (VAS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), alongside radio graphic assessments. Adverse events, range of motion, quality of life, and demographic factors were also examined. Data were collected from electronic medical records while maintaining patient confidentiality. Descriptive statistics using SPSS (IBM Corp., Armonk, NY, USA) were employed to analyze patient characteristics, treatment variables, and outcomes, with statistical significance determined using Chisquare test and Independent test.(7,33–36)

**Lung disease :-** The use of stem cells for treating lung diseases has great appeal. As we learn more about the therapeutic potential of stem cells and other cell therapies in clinical trials of non-lung diseases, we hope to be able to move toward further consideration of these approaches in lung diseases. In many lung diseases, cells that make up the respiratory system are either lost or do not function properly. A stem cell treatment that restores lung cell function might be able to reverse or even cure some lung diseases. As of now, there are no proven stem cell treatments for any lung disease, including COVID-19 and other respiratory infections from bacteria, viruses or fungi. There have been promising studies in animal models of lung diseases. Yet, there is no reliable evidence that stem cell treatments are effective for any lung disease. To date, there have been some legitimate clinical trials, approved and regulated by the FDA or by appropriate regulatory agencies in other countries. These have been done for a number of lung diseases including COPD3, acute respiratory distress syndrome4, idiopathic pulmonary fibrosis, and pulmonary hypertension. These studies have used several different types of cells including mesenchymal stromal cells and endothelial progenitor cells. Initial results suggest that the cells used appear to be safe over a short term period. However, further follow-up is necessary to ensure long term safety. Importantly, none of these studies have shown any beneficial effect in any lung disease tested so far.

A growing number of national and international respiratory disease societies and patient advocacy groups have taken strong positions against unproven stem cell therapies. This is also true for the leading stem cell scientific societies who do not support use of unproven stem cell therapies at this time. All of these groups are trying to educate patients, families, caregivers, and healthcare professionals about the potential dangers of unproven stem cell treatments. In the U.S., these foundations include the Alpha-1 Foundation, American Lung Association (ALA), COPD Foundation, Cystic Fibrosis Foundation, Pulmonary Fibrosis Foundation, and the Pulmonary Hypertension Association. None of these groups believes there is enough known about stem cell therapies to use them in lung disease without more research.(37-40)



## II. CONCLUSION

Stem cell therapy stands at the forefront of regenerative medicine, offering hope for the treatment of a wide range of diseases and conditions that were once considered incurable. Through its unique ability to differentiate into various cell types, stem cells can repair, replace, and regenerate damaged tissues, providing new therapeutic options for conditions such as Parkinson's disease, spinal cord injuries, diabetes, heart disease, and certain types of cancer. The advancement of stem cell research has led to significant breakthroughs, including successful clinical trials and ongoing exploration of its therapeutic applications. Adult stem cells, embryonic stem cells, and induced pluripotent stem cells each offer unique advantages and challenges, and researchers are continuously working to refine techniques for safe and effective use in patients. Despite its promise, stem cell therapy is not without challenges. Ethical concerns, particularly related to the use of embryonic stem cells, remain a topic of debate. In addition, issues related to immune rejection, tumor formation, and ensuring long-term safety and efficacy must be thoroughly addressed through rigorous clinical trials and regulatory oversight. Nonetheless, the future of stem cell therapy is bright. With increasing investment in research, advancements in biotechnology, and growing public interest, stem cell-based treatments are becoming more accessible and widely accepted. They not only hold the potential to transform the treatment of chronic and life-threatening diseases but also to improve the quality of life for countless individuals. In conclusion, while stem cell therapy is still evolving, its potential to revolutionize medicine is undeniable. Continued scientific inquiry, ethical considerations, and regulatory frameworks will play crucial roles in shaping its path forward. As we harness the power of stem cells, we move closer to a future where healing is not only possible but personalized and regenerative.

### **Bibliography:-**

- [1]. Stem-cell therapy. In: Wikipedia [Internet]. 2024 [cited 2025 Mar 20]. Available from: https://en.wikipedia.org/w/index.php?title=St em-cell\_therapy&oldid=1261162144
- [2]. (PDF) Stem Cell Therapy Current Scenario, Challenges and Future in India: A Review. ResearchGate [Internet]. 2024 Oct 22 [cited 2025 Mar 20]; Available from: https://www.researchgate.net/publication/379 380007\_Stem\_Cell\_Therapy\_-

\_Current\_Scenario\_Challenges\_and\_Future\_i n\_India\_A\_Review

- [3]. Viswanathan S, Rao M, Keating A, Srivastava A. Overcoming Challenges to Initiating Cell Therapy Clinical Trials in Rapidly Developing Countries: India as a Model. Stem Cells Transl Med [Internet]. 2013 Aug [cited 2025 Mar 23];2(8):607–13. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/P MC3726140/
- [4]. Bajada S, Mazakova I, Richardson JB, Ashammakhi N. Updates on stem cells and their applications in regenerative medicine. J Tissue Eng Regen Med. 2008 Jun;2(4):169– 83.
- [5]. Pérez López S, Otero Hernández J. Advances in Stem Cell Therapy. In: López-Larrea C, López-Vázquez A, Suárez-Álvarez B, editors. Stem Cell Transplantation [Internet]. New York, NY: Springer US; 2012 [cited 2025 Apr 6]. p. 290–313. (Advances in Experimental Medicine and Biology; vol. 741). Available from: http://link.springer.com/10.1007/978-1-4614-2098-9 19
- [6]. Swami DAA, Bhide DAR, Anuhya DK, Tharuni DJ, Vyawahare DVM. Stem Cell Therapy - Current Scenario, Challenges and Future in India: A Review. VIMS Health Sci J [Internet]. 2023 Jun 30 [cited 2025 Apr 6];10(2):61–7. Available from: https://vimshsj.edu.in/index.php/main/article/ view/387
- [7]. Raza T, Hassan SMT, Hashmi AMS, Zia OB, Inam M, Abidi SAR, et al. Efficacy and Safety of Stem Cell Therapy for Orthopedic Conditions, Including Osteoarthritis and Bone Defects. Cureus [Internet]. [cited 2025 Apr 6];16(7):e63980. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/P MC11299758/
- [8]. India SCC. Stem Cell Therapy For Covid-19 Patients [Internet]. 2021 [cited 2025 Mar 31]. Available from: https://www.stemcellcareindia.com/stem-celltherapy-for-covid-19-patients/
- [9]. Mahla RS. Stem Cells Applications in Regenerative Medicine and Disease Therapeutics. Int J Cell Biol [Internet]. 2016 [cited 2025 Apr 1];2016:6940283. Available from:

https://www.ncbi.nlm.nih.gov/pmc/articles/P MC4969512/



- [10]. International Journal of Surgery [Internet]. [cited 2025 Apr 1]. Available from: https://journals.lww.com/internationaljournal-ofsurgery/fulltext/2024/12000/revolutionizing\_ medicine\_recent\_developments\_and.55.aspx
- [11]. Embryonic Stem Cell an overview | ScienceDirect Topics [Internet]. [cited 2025 Apr 5]. Available from: https://www.sciencedirect.com/topics/bioche mistry-genetics-and-molecularbiology/embryonic-stem-cell
- [12]. Dame MCW// U of N. Center for Stem Cells and Regenerative Medicine. [cited 2025 Apr 5]. Adult Stem Cells // Center for Stem Cells and Regenerative Medicine // University of Notre Dame. Available from: https://stemcell.nd.edu/research/alternativestem-cell-sources/adult-stem-cells/
- [13]. About Adult Stem Cell Therapy [Internet]. [cited 2025 Apr 5]. Available from: https://www.kumc.edu/research/midweststem-cell-therapy-center/stem-cellinformation/about-adult-stem-celltherapy.html
- [14]. Induced pluripotent stem cells | UCLA BSCRC [Internet]. [cited 2025 Apr 5]. Available from: https://stemcell.ucla.edu/glossary/inducedpluripotent-stem-cells
- [15]. Cerneckis J, Cai H, Shi Y. Induced pluripotent stem cells (iPSCs): molecular mechanisms of induction and applications. Signal Transduct Target Ther [Internet]. 2024 Apr 26 [cited 2025 Apr 5];9(1):1–26. Available from: https://www.nature.com/articles/s41392-024-01809-0
- [16]. Ye L, Swingen C, Zhang J. Induced Pluripotent Stem Cells and Their Potential for Basic and Clinical Sciences. Curr Cardiol Rev [Internet]. 2013 Feb [cited 2025 Apr 6];9(1):63–72. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/P MC3584308/
- [17]. Stem Cells: Classifications, Controversies, and Clinical Applications - Fortier - 2005 -Veterinary Surgery - Wiley Online Library [Internet]. [cited 2025 Mar 24]. Available from: https://onlinelibrary.wiley.com/doi/10.1111/j. 1532-950X.2005.00063.x
- [18]. What are Stem Cells? | Where do Stem Cells Come From? [Internet]. [cited 2025 Mar 20].

Available from: https://www.cancer.org/cancer/managingcancer/treatment-types/stem-celltransplant/why-stem-cell-transplants-areused.html

- [19]. Part 1, Delhi 110025 JNN, at + 91-8743024344 IIP+ 91 8743024344 IP+ 91 7838223336 W. Stem Cell Therapy Safety and Risks In India - Stem Cell Care India Home [Internet]. 2018 [cited 2025 Mar 23]. Available from: https://www.stemcellcareindia.com/stem-celltherapy-safety-and-risks-india/
- [20]. Sánchez A, Schimmang T, García-Sancho J. Cell and tissue therapy in regenerative medicine. Adv Exp Med Biol. 2012;741:89– 102.
- [21]. Pérez López S, Otero Hernández J. Advances in Stem Cell Therapy. In: López-Larrea C, López-Vázquez A, Suárez-Álvarez B, editors. Stem Cell Transplantation [Internet]. New York, NY: Springer US; 2012 [cited 2025 Apr 6]. p. 290–313. Available from: https://doi.org/10.1007/978-1-4614-2098-9 19
- [22]. Current state of stem cell-based therapies: an overview PMC [Internet]. [cited 2025 Apr 6]. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC73 67472/
- [23]. Aly RM. Current state of stem cell-based therapies: an overview. Stem Cell Investig [Internet]. 2020 May 15 [cited 2025 Apr 6];7:8. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/P MC7367472/
- [24]. Hirsch T, Rothoeft T, Teig N, Bauer JW, Pellegrini G, De Rosa L, et al. Regeneration of the entire human epidermis using transgenic stem cells. Nature. 2017 Nov 16;551(7680):327–32.
- [25]. Treatment of Heart Diseases with Stem Cell Therapy | GenCell [Internet]. [cited 2025 Apr 6]. Available from: https://www.gencell.com.ua/en/ischemicheart-disease-coronary-heart-diseases
- [26]. The Use of Stem Cells in Cardiac Pathologies: A Review | Published in Georgetown Medical Review [Internet]. [cited 2025 Apr 6]. Available from: https://gmr.scholasticahq.com/article/94024the-use-of-stem-cells-in-cardiac-pathologiesa-review



- [27]. Stem Cell Therapy for Heart Failure Treatment [Internet]. [cited 2025 Apr 6]. Available from: https://www.webmd.com/heart-disease/heartfailure/stem-cells-heart-failure-treatment
- [28]. Stem Cell Therapy for Heart Failure (2024) [Internet]. [cited 2025 Apr 6]. Available from: https://www.dvcstem.com/post/stemcells-reverse-heart-disease
- [29]. Abdelwahid E, Siminiak T, Guarita-Souza LC, de Carvalho KAT, Gallo P, Shim W, et al. Stem Cell Therapy in Heart Diseases: A Review of Selected New Perspectives, Practical Considerations and Clinical Applications. Curr Cardiol Rev [Internet]. 2011 Aug [cited 2025 Apr 6];7(3):201–12. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/P MC3263484/
- [30]. Stem Cell Therapy for Neurological Disorders (2024) [Internet]. [cited 2025 Apr 6]. Available from: https://www.dvcstem.com/post/stem-celltherapy-for-neurological-disorders
- [31]. Rahimi Darehbagh R, Seyedoshohadaei SA, Ramezani R, Rezaei N. Stem cell therapies for neurological disorders: current progress, challenges, and future perspectives. Eur J Med Res [Internet]. 2024 Jul 25 [cited 2025 Apr 6];29(1):386. Available from: https://doi.org/10.1186/s40001-024-01987-1
- [32]. UI Hassan A, Hassan G, Rasool Z. Role of Stem Cells in Treatment of Neurological Disorder. Int J Health Sci [Internet]. 2009 Jul [cited 2025 Apr 6];3(2):227–33. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/P

MC3068820/

- [33]. SCP and Stem Cell Therapy for Knee Osteoarthritis [Internet]. [cited 2025 Apr 6]. Available from: https://regenorthosport.in/orthopedics/blog/sc p-and-stem-cell-therapy-for-kneeosteoarthritis/
- [34]. How Stem Cell Therapy Can Help With Joint Pain: Coastal Empire Orthopedics: Orthopedic Surgeons [Internet]. [cited 2025 Apr 6]. Available from: https://www.jonathanshultsmd.com/blog/how -stem-cell-therapy-can-help-with-joint-pain
- [35]. India SCC. What Are the Benefits of Stem Cell Therapy for Osteoarthritis? [Internet].2024 [cited 2025 Apr 6]. Available from: https://www.stemcellcareindia.com/what-are-

the-benefits-of-stem-cell-therapy-forosteoarthritis/

- [36]. Im GI. Clinical use of stem cells in orthopaedics. Eur Cell Mater. 2017 Feb 21;33:183–96.
- [37]. Stem cell therapies for chronic obstructive pulmonary disease: mesenchymal stem cells as a promising treatment option | Stem Cell Research & Therapy | Full Text [Internet]. [cited 2025 Apr 6]. Available from: https://stemcellres.biomedcentral.com/articles /10.1186/s13287-024-03940-9
- [38]. Pulmonary fibrosis: Is stem cell therapy the way forward? - PMC [Internet]. [cited 2025 Apr 6]. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10 590845/
- [39]. Caution on Stem Cell Therapy for Lung Diseases | American Lung Association [Internet]. [cited 2025 Apr 6]. Available from: https://www.lung.org/lung-healthdiseases/wellness/public-health-issues-lunghealth/stem-cell-therapy
- [40]. Unproven Stem Cell Treatments for Lung Disease—An Emerging Public Health Problem. Am J Respir Crit Care Med [Internet]. 2017 Apr 1 [cited 2025 Apr 6];195(7):P13–4. Available from: https://www.atsjournals.org/doi/10.1164/rcc m.1957P13