www.ijprems.com
editor@ijprems.com

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 04, Issue 08, August 2024, pp : 746-749

e-ISSN : 2583-1062
Impact Factor : 5.725

REGENERATIVE THERAPY TECHNIQUES FOR OSTEOARTHRITIS TREATMENT

Keerthana Solleti[1]

[1]Student, Green Level High School, Cary, North Carolina, USA

DOI: https://www.doi.org/10.58257/IJPREMS35818

ABSTRACT

Osteoarthritis is a degenerative joint disease that affects various parts of the joint, leading to chronic pain and reduced mobility. This paper explores innovative techniques such as regenerative medicine and targeted drug delivery systems to provide more effective and less invasive treatments for Osteoarthritis patients. Regenerative medicine techniques, particularly Stem cell therapy and Platelet-rich plasma treatment, offer promising research to relieve symptoms and potentially reversing joint damage. Stem cell therapy aims to regenerate and replace damaged cartilage tissue, while platelet-rich plasma leverages the body's healing mechanisms to promote joint repair and function improvement. These emerging techniques have the potential to lower treatment costs and improve the quality of life for the millions of people affected by Osteoarthritis.

Keywords: Osteoarthritis, Regenerative Therapy, Stem Cell Therapy, Platelet Rich Plasma, Joint Pain

1. INTRODUCTION

Osteoarthritis is one of the most common forms of arthritis, it is a disease that progressively damages areas of the joint, which includes the cartilage, tendons, ligaments, synovium, bone, and meniscus. It often starts with the gradual breakdown of cartilage, which acts as a cushion between bones, this leads to joint stiffness and pain. As the cartilage wears away, the bones begin to rub against each other, causing further damage and inflammation within the joint. This condition causes chronic pain and reduced mobility, and typically appears in humans after the age of 40 and becomes more common with older age.

In 2020, Osteoarthritis affected around 595 million people worldwide, representing 7.6% of the world's population [1] —a staggering 132.2% increase since 1990. The impact of this disease is particularly seen in the United States, where the Center for Disease Control (CDC) reports that approximately one in five adults (around 53 million) suffer from some form of arthritis [2]. The economic burden of Osteoarthritis, including both the direct medical expenses and the indirect costs such as lost productivity, is substantial, accounting for 1 to 2.5% of the gross national product (GNP) in countries with established market economies [3].

2. TRADITIONAL JOINT TREATMENT TECHNIQUES

Currently, Doctors do not have a cure for Osteoarthritis, but treatment techniques generally fall into the listed three categories below:

Medications: Doctors can prescribe anti-inflammatory medication to decrease pain. Patients can use these medications either over the counter or through prescriptions in the form of pills, gels, creams, or injections. For low severity conditions, doctors often suggest Nonsteroidal anti-inflammatory drugs (NSAIDs) such as aspirin, ibuprofen, or celecoxib. For moderate severity conditions, doctors tend to prescribe anti-inflammatory medication pills containing "corticosteroids" to help with inflammation. Doctors also inject medicine directly into the affected joint to reduce inflammation. In serious situations, surgery is highly recommended.

Non-Medicine Therapies: Many doctors believe that movement is essential in the treatment of Osteoarthritis. Doctors may suggest exercises patients can perform under the guidance of a physical therapist, often recommending up to 120 minutes of moderate to vigorous exercise per week. These exercise programs help build muscle around painful joints and slowly ease stress on them. Motion requiring or stretching exercises help reduce stiffness and keep joints moving. Aerobic and cardio exercises improve stamina and energy levels and help reduce excess weight. Losing extra weight reduces pain and helps avoid further joint damage. Studies show that by losing 1 pound, it would relieve 4 pounds of pressure from your knees. [11]

Surgery: Surgical intervention, specifically joint replacement, is a common approach used by orthopedic surgeons to relieve pain and restore proper joint function. By replacing damaged joints, this procedure aims to improve mobility and relieve any discomfort the patient may be experiencing. Surgeons now use advances in technologies such as 3D Bioprinting to revolutionize the production of joint implants. Materials that have been developed are durable and biocompatible joint implant materials. While surgery offers an effective treatment option, patients often require extensive recovery periods. The advanced techniques can be costly and may not be accessible to everyone around the world, especially in developing nations.

www.ijprems.com
editor@ijprems.com

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 04, Issue 08, August 2024, pp : 746-749

e-ISSN : 2583-1062
Impact Factor : 5.725

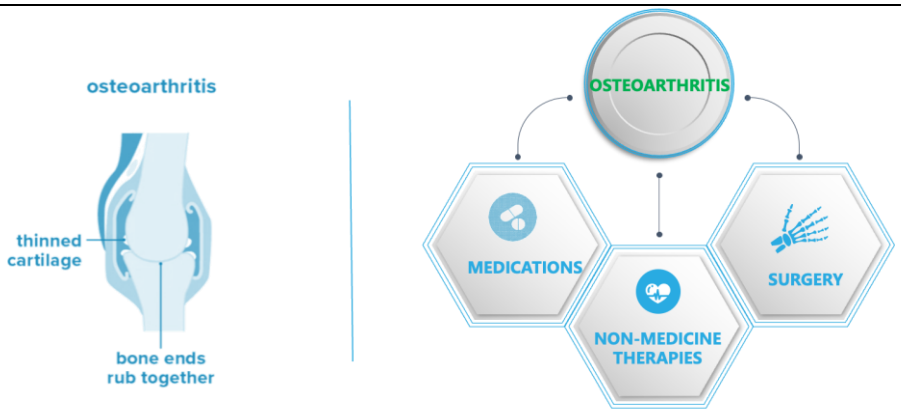

Figure1: Osteoarthritis and Treatment Choices

These existing treatment options are often widely utilized, but each approach has significant drawbacks. Medications can cause side effects, may lose effectiveness over time, and although it may relieve pain, they do not cure the disease permanently. Non-medicine therapies require significant time and effort from patients and may not provide sufficient relief for advanced cases. Surgery is invasive, expensive, and not universally accessible. These limitations underscore the need for more innovative and comprehensive treatment options.

3. NEW METHOD AND TECHNIQUES

This paper explores new techniques, such as regenerative medicine and targeted drug delivery systems, in hopes of providing more effective, less invasive, and more accessible treatments for Osteoarthritis patients worldwide.

Stem Cell Therapy: The human body is composed of various types of cells, each performing a specific function. For example, red blood cells transport oxygen throughout the body, muscle cells aid in the growth and repair of muscle tissue, and epithelial cells form the skin layer. Unlike these, there are also Stem Cells or “Unspecialized Cells”. These stem cells are termed "unspecialized" because they do not have a defined function. Instead, they have the potential to mature and differentiate into different cell types, including those that form bone, tendon, ligament, cartilage, muscle, and meniscus. Additionally, these stem cells can self-renew, producing even more stem cells. They can also prevent other cells from dying due to a lack of oxygen and produce anti-inflammatory proteins.

When stem cells are injected into an arthritic joint or injured tendon, they attach to the damaged areas. The cells then can sense the injury's microenvironment and determine what type of cells to grow, and which molecules are needed to enhance tissue healing. The stimulated stem cells begin to grow new cells and act as the body's natural drug store, producing and releasing the right combination of growth factors and proteins to stimulate healing and new growth of cartilage, tendon, and other injured tissues. The goal of stem cell therapy for Osteoarthritis is to reduce pain and improve function by regenerating cartilage tissue and reversing some of the joint damage.

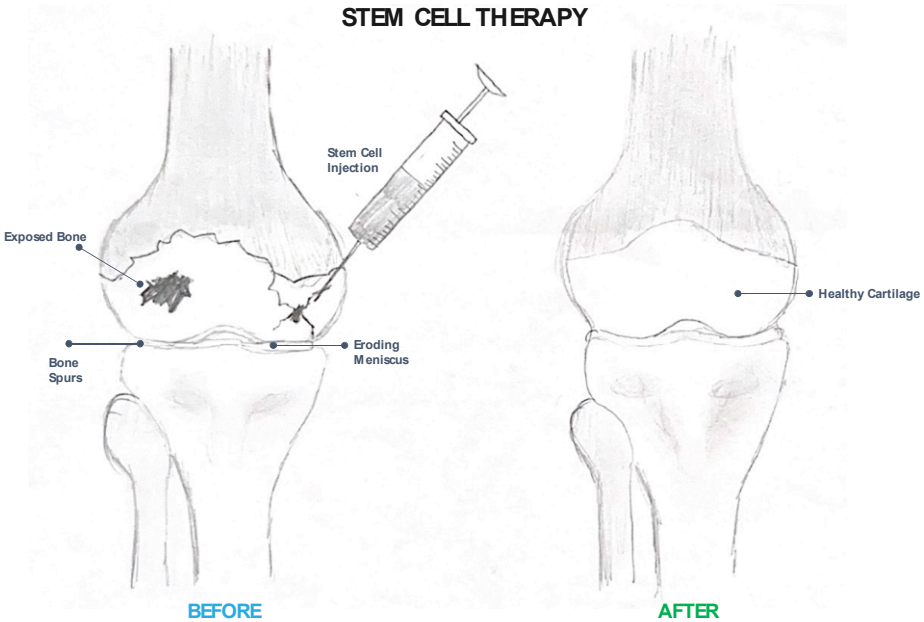

Figure2: Stem Cell Therapy for Treating Osteoarthritis

www.ijprems.com
editor@ijprems.com

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 04, Issue 08, August 2024, pp : 746-749

e-ISSN : 2583-1062
Impact Factor : 5.725

Stem cell therapy as a treatment technique for Osteoarthritis patients helps regenerate lost cartilage and delay the worsening of their arthritis. Patients can opt for stem cell therapy when conventional treatments with medication or non-medication therapy have failed to provide adequate relief. Additionally, patients who wish to avoid surgery, or are not good candidates for surgery, can find stem cell therapy to be a great treatment alternative.

Platelet Rich Plasma Injections

As an alternative, Platelet-rich plasma (PRP) therapy offers a promising treatment for Osteoarthritis. This approach uses the body's own healing mechanisms to potentially reduce pain and improve joint function. Here's how it works:

Doctors extract a small amount of the patient's blood and process it through centrifugation to concentrate the platelets. This concentrated solution, known as platelet-rich plasma, contains a higher concentration of platelets than whole blood [4]. When injected into the affected joint, PRP stimulates an immunological and inflammatory response that supplements the body's natural healing processes [5-8].

The key to PRP's effectiveness lies in the growth factors and cytokines released by activated platelets. These include platelet-derived growth factor (PDGF), transforming growth factor (TGF), insulin-like growth factor (IGF), fibroblast growth factor (FGF), and vascular endothelial growth factor (VEGF) [6-9]. Together, these substances promote tissue healing through various mechanisms:

1. Angiogenesis: Formation of new blood vessels
2. Cellular migration: Movement of cells to the injury site
3. Proliferation: Increase in the number of healing cells
4. Matrix deposition: Laying down of new tissue

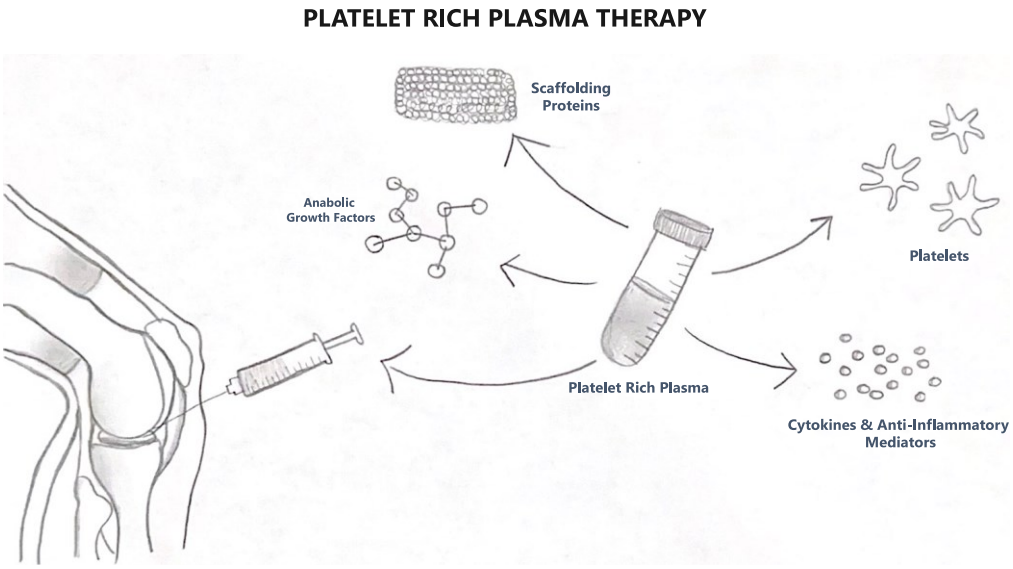

Figure 3: Platelet Rich Plasma Therapy for Treating Osteoarthritis

By conducting these processes, PRP therapy aims to reduce inflammation, alleviate pain, and potentially slow the progression of Osteoarthritis. As an autologous treatment (using the patient's own blood), PRP may have fewer risks of undesired reactions compared to some traditional treatments. However, this treatment technique needs further clinical studies before fully establishing its long-term approach to treat Osteoarthritis.

4. CONCLUSION

This research paper explains the need for innovative approaches for Osteoarthritis treatment. Current treatment options like medications, non-medicine therapies, and surgery present significant limitations that impact patient outcomes and quality of life.

Regenerative medicine techniques, particularly stem cell therapy and platelet-rich plasma (PRP) treatment, provide promising avenues for additional Osteoarthritis care. These emerging therapies offer the prospect of not only alleviating symptoms but potentially reversing joint damage, a capability beyond the scope of traditional treatments. Stem cell therapy shows promise in regenerating cartilage tissue, while PRP leverages the body's intrinsic healing mechanisms to promote joint repair and function improvement.

As the research community continues to explore and refine regenerative treatment techniques, this study lays the groundwork for future investigations and clinical trials, paving the way for a new paradigm in Osteoarthritis management. By pursuing these innovative therapies, we aspire to lower treatment costs and improve the lifestyle of millions affected by this condition.

5. REFERENCES

[1] U.S. National Library of Medicine. (n.d.). *Global, regional, and national burden of osteoarthritis, 1990-2020 and projections to 2050: A systematic analysis for the global burden of disease study 2021*. The Lancet. Rheumatology. https://pubmed.ncbi.nlm.nih.gov/37675071/

[2] Fallon EA, Boring MA, Foster AL, et al. Prevalence of Diagnosed Arthritis — United States, 2019–2021. MMWR Morb Mortal Wkly Rep 2023;72:1101–1107.

[3] The burden of OA-health services and economics. V.P. Leifer,, J.N. Katz, E. Losina. Osteoarthritis and Cartilage Research Article | Volume 30, ISSUE 1, P10-16, January 2022.

[4] Nguyen RT, Borg-Stein J, McInnis K. Applications of platelet-rich plasma in musculoskeletal and sports medicine: an evidence-based approach. Pm r 2011;**3**(3):226-50 doi: 10.1016/j.pmrj.2010.11.007.

[5] Holinstat M. Normal platelet function. Cancer Metastasis Rev 2017;**36**(2):195-98 doi: 10.1007/s10555-017-9677-x.

[6] Blair P, Flaumenhaft R. Platelet alpha-granules: basic biology and clinical correlates. Blood Rev 2009;**23**(4):177-89 doi: 10.1016/j.blre.2009.04.001 [published Online First: 20090517].

[7] Brophy RH, Marx RG. The treatment of traumatic anterior instability of the shoulder: nonoperative and surgical treatment. Arthroscopy 2009;**25**(3):298-304 doi: 10.1016/j.arthro.2008.12.007.

[8] Wang D, Rodeo SA. Platelet-Rich Plasma in Orthopaedic Surgery: A Critical Analysis Review. JBJS Rev 2017;**5**(9):e7 doi: 10.2106/jbjs.Rvw.17.00024.

[9] Hurley ET, Sherman SL, Stokes DJ, et al. Experts Achieve Consensus on a Majority of Statements Regarding Platelet-Rich Plasma Treatments for Treatment of Musculoskeletal Pathology. Arthroscopy 2024;**40**(2):470-77.e1 doi: 10.1016/j.arthro.2023.08.020 [published Online First: 20230823].

[10] Platelet-rich plasma for osteoarthritis: AOSSM sports medicine news. AOSSM. (n.d.). https://www.sportsmed.org/membership/sports-medicine-update/spring-2024/platelet-rich-plasma-for-osteoarthritis-in-2024

[11] Weight loss benefits for arthritis: Arthritis foundation. Weight Loss Benefits for Arthritis | Arthritis Foundation. (n.d.). https://www.arthritis.org/health-wellness/healthy-living/nutrition/weight-loss/weight-loss-benefits-for-arthritis