



## Pharmacological and Biologic Strategies to Slow Osteoarthritis Progression and Reduce Surgical Burden: Clinical and Translational Implications

### Article History:

#### Name of Author:

<sup>1</sup>Dr. Sher Dil Khan, <sup>2</sup>Dr. Zeehan Naeem

<sup>3</sup>Dr. Naveed Ahmed Jumani, <sup>4</sup>Dr. Ghazanfar Ali Shah

**Affiliation:** <sup>1</sup>Assistant Professor, Prime Medical and dental college Islamabad Email: [shetry100@gmail.com](mailto:shetry100@gmail.com)

<sup>2</sup>Head of Department orthopedic surgery Sindh govt qatar hospital Karachi, Email : [zeehan.naeem84@gmail.com](mailto:zeehan.naeem84@gmail.com)

<sup>3</sup>Senior registrar Kmc civil hospital khairpur mirs Khairpur Mir's Sindh, Email: [Dr.naveedjumani@gmail.com](mailto:Dr.naveedjumani@gmail.com)

<sup>4</sup>Consultant Orthopaedic Surgeon, Shaheed Mohtarma Benazir Bhutto Institute Of Trauma, (SMBB-IT, Assistant Professor, Dow University Of Health Sciences, DUHS, Email: [ghazi9321@gmail.com](mailto:ghazi9321@gmail.com)

#### Corresponding Author:

Dr. Sher Dil Khan

**Received:** 16-11-2025

**Revised:** 04-12-2025

**Accepted:** 18-12-2025

**Published:** 31-12-2025

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Noncommercial-Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**Abstract: Background:** Knee osteoarthritis is a progressive degenerative joint disease and one of the major causes of chronic pain, functional limitation and disability in the world. In spite of the fact that in total knee arthroplasty end-stage disease is effectively managed, the demand of surgeries has emerged as a major challenge to the healthcare system. There is, therefore, an increasing interest on therapeutic interventions that have the potential to decelerate the disease progression, relieve the symptoms, delay or decrease the necessity of surgical procedures. Pharmacological agents have symptomatic efficacy with limited effect on structural disease modification whereas the potential emergence of biologic agents can directly target the underlying generation of osteoarthritis pathophysiology. **Objectives :** To assess the existing pharmacological / biologic interventions to the treatment of knee osteoarthritis with regard to their ability to delay the disease pathogenesis and decrease the surgical workload and address the clinical/translation implications of these therapies. **Methods:** A systematic review of clinical narrative literature on pharmacological and biologic interventions in knee osteoarthritis was carried out, as was published since 2018. Randomized controlled trials and systematic reviews and clinical guidelines evidence were synthesized. Additionally, primary observational data of a tertiary care hospital and the results of a small patient-reported outcome survey were included to facilitate clinical interpretation in real-life. Interest outcomes included reduced pain, functional outcome, safety and delay surgical intervention implications. **Results:** Pharmacological treatment, such as nonsteroidal anti-inflammatory medications and intra-articular corticosteroids, were effective in the treatment of symptoms in the short term but showed little disease-modifying effects. It has been demonstrated that biologic approaches, especially using platelet-rich plasma, produced more long-lasting pain and functional benefits, especially when used in the mild to moderate cases of knee osteoarthritis. New biologic and disease-modifying methods showed promising translational potential, but there is limited clinical evidence over the long-term. The side effects of both types of therapies were usually mild and correctable. **Conclusion:** A combination of pharmacological and biologic treatments can be significant in the delay of development of osteoarthritis of the knee and prevent the surgical interventions. The biologic approaches, particularly platelet-rich plasma seem to have a potential, and more standardized long-term trials are needed to establish the ideal treatment plans and to establish whether they have an effect on the burden of surgery.

**Keywords:** Knee osteoarthritis; pharmacological therapy; biologic therapy; platelet-rich plasma; disease modification; surgical burden; translational medicine

## INTRODUCTION

Knee osteoarthritis (OA) is a systemic degenerative joint disease that is chronic and progressive in nature, and the cause of pain, disability, and loss of independence among the majority of the global population (1). The rate of its prevalence is still growing along with the age of the population, the obesity rates, and the lifespan, leaving a heavy burden on both patients and healthcare systems (2). Knee OA is clinically manifested by painful, stiffness, restricted range of movement, and decreased functional capacity, which in most cases leads to a low mobility level and quality of life.

The ultimate management of end stage disease includes total knee arthroplasty that offers credible relief of symptoms. Nevertheless, the anticipation of knee replacement surgery surging in the next few decades has generated some fears on the capacity of healthcare, the cost, and the rate of revision surgery (2). This is why an increasing attention is paid to therapeutic interventions which have the potential to slow down disease progression, preserve joint functionality, and delay or minimize surgical intervention. This has been the impetus behind the development of interest in pharmacological and biologic interventions that variously address the pathophysiology of osteoarthritis.

The standard pharmacological treatment of knee OA is mainly aimed at the management of the symptoms. Nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly used and effective in the short term treatment of pain but there is limitation of their long term use by adverse gastrointestinal, cardiovascular, and renal effects (3). The intra-articular injection of corticosteroids is widely used in the treatment of acute exacerbation of symptoms and may be associated with immediate pain relief, but frequent use of injections has been linked to the cartilage volume loss and short effect duration (4). Slow-acting osteoarthritis symptomatic systemic glucosamine and chondroitin sulfate (SYSADOAs) are still controversial with contradictory evidence in how well they improve clinical outcomes and modify the disease (5).

The purpose of hyaluronic acid injections is to recover the viscoelasticity of the synovial fluid and enhance the lubrication of the joints. Although there are reports of moderate symptomatic improvement in some patients, clinical responses are inconsistent and the impact on the structural disease progression is minimal (3). Together, these pharmacological treatments provide beneficial symptom improvement but fail to provide any reliable change in the underlying degenerative process, which demonstrates the necessity of more biologically specific treatments.

The recent progress in the knowledge of osteoarthritis as a heterogeneous and biologically active disease has enhanced the creation of disease-modifying and regenerative approaches (6). Translational studies have shown that inflammatory mediators, cartilage metabolism, subchondral bone remodeling as well as synovial pathology all play a role in disease progression (7). This shifting paradigm has made biologic therapies the potential candidates in changing intra-articular environment instead of just relieving symptoms.

Platelet-rich plasma (PRP) is one of the biologic methods that have received the most extensive research and clinical implementation in knee OA treatment. PRP is an autologous product of blood that is enhanced with platelets and growth factors that have functions in the regulation of inflammation, angiogenesis, and tissue restoration (8,9). A number of randomized controlled trials and meta-analyses of recent studies have documented better and more long-term pain and functional outcomes with PRP relative to hyaluronic acid or corticosteroids, especially in patients with mild to moderate disease (10,11). Notably, PRP has proven to have an excellent safety profile which is yet another positive indicator of its clinical interest (12).

Other biologic and regenerative approaches in addition to PRP such as mesenchymal stem cell-based therapies and autologous conditioned serum are also being studied. Although these strategies have yielded encouraging results in the initial stages, the strategies are still constrained by regulatory, cost, and standardization issues (12,13). Simultaneously, translational research has yet to develop new disease-modifying osteoarthritis drugs (DMOADs) that can modify cartilage degeneration and inflammatory signalling pathways, but has been slow to translate into clinical use (6,7).

With the growing therapeutic space and the urgency to decrease the surgical burden, an overall assessment of the existing pharmacological and biologic approaches should be conducted. This paper will seek to present a clinical and translational approach of therapies that could be used to reduce the advances of knee osteoarthritis and extend to surgery. This review aims to inform clinicians on the best practices and future trends in the management of knee OA by combining the recent evidence with practical clinical experience.

## MATERIALS AND METHODS

### Study Design

This paper was carried out under the form of the systematic clinical narrative review that was

supported by primary observational data in a tertiary orthopedic hospital. The standpoint of methodological frame was designed to assess pharmacological and biologic approaches which are targeting to retard the advancement of knee osteoarthritis and alleviate the need of surgical intervention. This part was formatted and structured according to already published clinical perspective papers, and only changes were made regarding the focus of treatment and the population under investigation.

#### **Setting and Population of the study.**

Primary data were retrieved at one of the tertiary care hospitals dealing with orthopedic and musculoskeletal disorders. The patients diagnosed with mild to moderate knee osteoarthritis (Kellgren–Lawrence grades I–III) were included in the study population age 40–75 years and with clinical and radiographic findings. Patients who came in with advanced osteoarthritis (grade IV), inflammatory arthritis, and those who had undergone knee arthroplasty previously, recent intra-articular injection (within the past six months) and those with systemic bleeding disorders were excluded.

Primary data were comprised of 48 patients who had undergone non-surgery of knee osteoarthritis within the period of study. Among them, one of the subsets underwent biologic treatment, i.e. platelet-rich plasma, and the other subsets were treated using conventional pharmacological treatment.

#### **Sampling Method**

The sampling technique used was a consecutive sampling technique in which all the qualified patients who met the inclusion criteria within the study time were enrolled. This selection method was chosen to reduce the selection bias and to be representative of the real-world clinical practice. To complete the narrative review aspect, purposive sampling was applied in order to find the topical clinical studies which were published since January 2018 and April 2024.

#### **Data Collection Procedures**

Clinical data were collected retrospectively from patient medical records and follow-up Patient medical records and follow-up evaluations were used as retrospective sources of clinical data. The age, sex, body mass index, radiographic grade of osteoarthritis, laterality of involvement, and prior treatments were the baseline variables. Outcome data was collected at baseline and 12 weeks follow-up.

Visual Analog Scale (VAS) was used to measure the intensity of pain. Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) was used to assess functional status. At the follow-up, a

short patient-reported satisfaction scale was conducted to identify the perceived enhancement of daily activities and treatment overall satisfaction.

In the review element, PubMed, Scopus, and Google Scholar were searched electronically with a combination of the keywords associated with knee osteoarthritis, pharmacological treatment, biologic treatment and platelet-rich plasma. The suitable studies were filtered according to pre-stipulated inclusion criteria, and information was collected through standardized templates.

#### **Therapeutic Interventions**

Pharmacological treatment involved the use of oral nonsteroidal anti-inflammatory drugs, osteoarthritis symptomatic slow-acting drugs, and intra-articular corticosteroid or hyaluronic acid injections when clinically indicated. The biologic therapy involved intra-articular injections of platelet-rich plasma that was made under a standardized protocol of the double-spin centrifugation method. Depending on the clinical response, the PRP injection was between one and three.

#### **Variables and Outcome Measures**

The main outcome measures were the change in pain level (VAS) and functional level (WOMAC score) at the baseline and the follow-up stages. Patient-reported satisfaction and the need to escalate to surgical consultation were considered as secondary outcome measures as well as the adverse events.

#### **Ethical Considerations**

The narrative review part entailed a secondary review of published data and did not necessitate any ethical approval. Analysis of the institutional data was anonymized before the analysis and informed consent was received before including the clinical data and survey responses of the patients. The research complied with the ethical principles of conducting clinical study and patient confidentiality.

#### **Statistical Analysis**

Baseline characteristics and outcome measures were summarized through the use of descriptive statistics. Continuous variables were represented as means and standard deviations and those that are categorical as frequencies and percentage. Paired statistical tests were used to compare the baseline and follow-up scores on pain and functional scores. The level of statistical significance was set at  $p < 0.05$ .

#### **Data Management and Reliability**

To achieve accuracy and consistency, two investigators independently reviewed all the data. Agreements were reached by discussing and reaching a consensus on the discrepancies. The validity and reliability of the findings were improved by the use of validated outcome measures and the application of

standardized data extraction procedures.

RESULTS

The findings are made in the form of a narrative review of primary observational data of a tertiary care facility with evidence by secondary sources of recent published literature (2018-2024). The results are structured into baseline features, clinical features of pharmacological and biologic interventions, patient reports, safety, and comparative evidence. Tables are placed as soon as they are mentioned first according to the standard reporting rules.

Baseline Demographic and Clinical Characteristics (Primary Data)

The primary data was a sample of 48 patients with confirmed knee osteoarthritis in terms of the clinical and radiographic evidence obtained at the tertiary care hospital. The cohort age is 59.2 years of average, and the range of the age is 42-74 years (62.5% of female proportion). The majority of patients were reported with the KellgrenLawrence grade II and grade III and grade I disease osteoarthritis. The unilateral involvement on the knee was dominant compared to bilateral involvement.

In relation to the exposure to treatment, the patients were treated with a mix of clinical indication-based combination of pharmacological and biologic treatment. The intervention was done on 26 patients undergoing biologic therapy consisting of intra-articular platelet-rich plasma and the rest of the patients were subject to pharmacological therapies such as NSAIDs, intravenous corticosteroids and hyaluronic acid injections.

Baseline demographic and clinical characteristics of the study population are summarized in Table 1

Baseline Demographic and Clinical Characteristics of Patients with Knee Osteoarthritis

| Variable                           | Value      |
|------------------------------------|------------|
| Mean age (years), mean ± SD        | 59.2 ± 8.1 |
| Age range (years)                  | 42–74      |
| Sex, n (%)                         |            |
| Female                             | 30 (62.5)  |
| Male                               | 18 (37.5)  |
| Body mass index (kg/m²), mean ± SD | 28.4 ± 3.6 |
| Kellgren–Lawrence grade, n (%)     |            |
| Grade I                            | 9 (18.8)   |
| Grade II                           | 25 (52.1)  |
| Grade III                          | 14 (29.1)  |
| Laterality of involvement, n (%)   |            |
| Unilateral                         | 31 (64.6)  |
| Bilateral                          | 17 (35.4)  |
| Primary treatment modality, n (%)  |            |
| Pharmacological therapy only       | 22 (45.8)  |
| Biologic therapy (PRP)             | 26 (54.2)  |
| Mean follow-up duration (weeks)    | 12 ± 2     |

Clinical Outcomes Following Treatment (Primary Data)

Pain Reduction

The intensity of pain measured by the use of the Visual Analog Scale (VAS) improved significantly after treatment. Overall cohort mean VAS scores declined to 3.4 ± 1.3 at 12-week follow-up than baseline (6.6 1.1).

In the treatment modality stratified, biologic therapy using PRP had a higher reduction in pain than patients treated to PRP therapy using pharmacological therapy. PRP group recorded a drop in mean VAS score of 6.7 ± 1.0 to 2.9 ± 1.2, and pharmacological therapy group recorded a drop of 6.5 ± 1.2 to 3.9 ± 1.4.

Functional Outcomes

The WOMAC index was used to measure functional status, which improved significantly after the treatment. The average WOMAC score of the whole cohort was reduced at the baseline to 57.9 with the standard deviation of 9.8 and 40.6 with the standard deviation of 9.1 at the baseline and the follow-up respectively (p < 0.001). There was also an improvement in pain, stiffness, and physical function subscales.

The PRP patients showed more functional improvement as compared to patients who were treated using pharmacological therapy. PRP group also showed a mean decrease of WOMAC of 21.1 points in comparison to 13.2

decrease in pharmacological therapy group.  
Clinical outcome measures following treatment are presented in **Table 2**.

**Table 2 Clinical Outcomes Following Pharmacological and Biologic Interventions for Knee Osteoarthritis (Primary Data)**

| Outcome Measure                        | Baseline    | Follow-up  | Mean Change | p-value |
|----------------------------------------|-------------|------------|-------------|---------|
| VAS pain score (overall)               | 6.6 ± 1.1   | 3.4 ± 1.3  | -3.2        | <0.001  |
| VAS pain score (PRP group)             | 6.7 ± 1.0   | 2.9 ± 1.2  | -3.8        | <0.001  |
| VAS pain score (pharmacological group) | 6.5 ± 1.2   | 3.9 ± 1.4  | -2.6        | <0.01   |
| WOMAC score (overall)                  | 57.9 ± 9.8  | 40.6 ± 9.1 | -17.3       | <0.001  |
| WOMAC score (PRP group)                | 58.4 ± 9.6  | 37.3 ± 8.4 | -21.1       | <0.001  |
| WOMAC score (pharmacological group)    | 57.3 ± 10.1 | 44.1 ± 9.7 | -13.2       | <0.01   |

**Patient-Reported Outcomes and Satisfaction**

Seventy-nine point two percent of patients at follow-up were subjectively improving in their daily activity in terms of walking, stair climbing, endurance of standing. The overall treatment satisfaction was between good and excellent to 81.3% of the patients. Patients who used PRP were found to have greater levels of satisfaction when compared to those using pharmacological therapy only.

In a small patient-reported outcome study, sustained pain relief and increased mobility were found to be the most desirable aspects of a treatment by patients, especially those wishing to postpone or prevent surgery.

**Safety and Adverse Events**

Each of treatment modalities showed good safety profile. The cases of mild, self-limiting adverse events were noted in few patients and were transient post-injection discomfort and localized swelling. The follow-up period did not exhibit any serious adverse events, infections, or complications of treatment. None of the patients needed immediate increase to surgery during the period of study.

**Summary of Secondary Evidence from Published Studies**

The secondary evidence is clinical trial and systematic reviews and meta-analysis published between 2018 and 2024, and the short-term effect on symptoms and limited disease-modifying effect of pharmacological therapies were consistent across the studies. On the contrary, biologic methods, especially PRP, were correlated with better and more long-term pain and functionality related to the decrease in patients with early to moderate knee arthritis. Key characteristics and outcomes of published studies evaluating pharmacological and biologic strategies for knee osteoarthritis are summarized in **Table 3**.

**Table 3 Summary of Pharmacological and Biologic Strategies for Knee Osteoarthritis (Secondary Evidence, 2018–2024)**

| Therapy            | Mechanism                     | Clinical Benefit                        | Limitations                        |
|--------------------|-------------------------------|-----------------------------------------|------------------------------------|
| NSAIDs             | Anti-inflammatory             | Short-term pain relief                  | Systemic adverse effects           |
| Corticosteroids    | Inflammatory suppression      | Rapid symptom relief                    | Short duration; cartilage concerns |
| Hyaluronic acid    | Viscosupplementation          | Modest functional benefit               | Variable response                  |
| PRP                | Growth factor-mediated repair | Sustained pain and function improvement | Protocol variability               |
| Emerging biologics | Regenerative modulation       | Potential disease modification          | Limited long-term evidence         |

**Results Summary**

Overall, the evidence provided in primary tertiary care hospitals showed that pain and function improvement after both pharmacological and biologic treatment of knee osteoarthritis is significant and more and long-term in patients who receive biologic treatment with PRP. These results were aligned with the recently published materials that aid the efficacy of biologic strategies as effective strategies of decelerating the development of the disease and lowering the level of surgical loads among the selective patients.

## DISCUSSION

The aim of this research was to determine the current pharmacological and biologic methods of knee osteoarthritis (OA) management and how it might slow the progression of the disease and decrease surgical demand using primary tertiary care hospital data with the aid of the latest published evidence (2018-2024). The results emphasize the presence of significant variations between traditional pharmacological and new biologic treatment, especially platelet-rich plasma (PRP) regarding the long-term maintenance of the symptom, functional, and translational viability.

### Interpretation of Primary Clinical Findings

The tertiary care cohort primary data showed that both pharmacological and biologic treatment had a significant effect on pain and function improvement during the short-term follow-up. Nevertheless, patients undergoing biologic treatment using PRP always had more pain scores decrease and WOMAC functional outcomes improvement than those treated with pharmacological treatment only. These results indicate that despite the fact that classical therapies are still useful in terms of control of symptoms, biologic therapy can be a clinical enhancement in a few patients.

The level of pain reduction with PRP group was both meaningful clinically and consistent with levels typically to determine response to treatment in knee OA. There were also significant functional gains which are changes in activities of daily living that include walking, stair climbing and standing. Notably, these results were obtained despite the lack of a higher risk of adverse events, which speaks in favor of the safety and applicability of biologic therapy in everyday clinical practice.

### Pharmacological Strategies: Role and Limitations

Knee OA treatment largely relies on pharmacological treatment especially at the onset of the disease and when the patient is not qualified to undergo invasive surgery. NSAIDs and intra-articular corticosteroids are effective in the short-run pain treatment as was revealed by the observed amelioration in the pharmacological group of treatment. Nonetheless, the lower and less persistent enhancement in comparison with PRP highlights the already known weaknesses of such agents.

Although corticosteroids are useful in acute flares of the symptoms, their persistence is limited and there are possible adverse effects of this drug in cartilage when used regularly. Likewise, injections of hyaluronic acid show variable clinical effects, and show mixed results in disease modification. It is these constraints that underlie the potential ineffectiveness

of pharmacological interventions in certain cases when it comes to changing the morbidity and/or postponing the need to engage in surgical procedures. **Biologic Strategies and Translational Implications**

Biologic therapies are a new approach to treating osteoarthritis by addressing the underlying biological processes in osteoarthritis instead of concentrating on suppressing the symptoms. The most researched biologic therapy in knee OA, PRP, showed a better result in primary and secondary data. The pain relief and functional improvement are maintained and this is in line with the results of recent randomized controlled trials and meta-analysis.

Translational wise, the mechanism of action of PRP, which is inflammation modulation, tissue repair, and possibly cartilage metabolism, justify it as a biologically active therapy, but not a symptomatic treatment. Although there is still no evidence of definitive disease-modifying effects, there is emerging evidence that PRP can positively change the intra-articular environment, especially in early to moderate OA.

Mesenchymal stem cell-based therapies, mesenchymal stem cell-derived autologous conditioned serum, are being actively studied as other biologic therapies. Despite the encouraging initial outcomes, the therapies have difficulties associated with standardization, regulation, cost, and long-term safety. Accordingly, their daily clinical use is still restricted and PRP is at present the most convenient and accessible biologic in most medical facilities.

### Implications for Reducing Surgical Burden

Among the greatest clinical implications of these findings is the possibility of using biologic therapies to either postpone or decrease the necessity of having total knee arthroplasty. As the number of knee replacement surgeries is expected to grow and put more pressure on health care systems, any measures that would allow extending the lifespan of joints and postponing surgery are of great significance.

The patient-reported satisfaction and functional improvement demonstrated in the group of patients receiving PRP are high, which can indicate that biologic therapy can allow the patients to preserve a decent quality of life over a more extended period of time. Although time to surgery was not directly observed in the present study, there was no early surgical escalation and the hypothesis was supported by the published evidence that biologic interventions can decrease the burden of surgery, when used as part of overall pathways in OA management.

### Patient Selection and Clinical Application

The selection of patients is also vital in making the best out of biologic therapies. Both primary and secondary data show that PRP is the most effective in patients with mild-moderate knee osteoarthritis, intact joint space, and reduced inflammatory load. Disease with severe structural damage that is advanced is less likely to respond to biologic intervention and might still be in need of surgical intervention.

PRP ought to be included in the multimodal approach in clinical practice comprising lifestyle change, physiotherapy, and suitable pharmacological support. The personal treatment planning based on the severity of the disease, patient expectations and comorbidities are necessary to maximize benefit and prevent inappropriate use.

### Safety Considerations

The results of safety in both types of therapies were satisfactory. None of the tertiary care cohort showed any major adverse events and side effects were self-limiting. Its autologous quality probably makes PRP a desirable choice due to its desirable safety profile and an opportunity to be offered to the patients who want to have an alternative to repeated corticosteroid injections or use of nonsteroidal anti-inflammatory drugs on a long-term basis.

### Limitations and Future Directions

There are a number of constraints that are to be accepted. The main source of data was one center with a small sample and short follow-ups, which did not allow generalization and evaluation of long-term outcomes. The observational design does not allow causal inference and structural progression measures based on imaging were unavailable.

Future studies are encouraged to use large multicentric randomized studies with standard PRP preparation regimens, prolonged follow up and structural and biomarker outcomes. The use of comparative studies to compare pharmacological-biologic treatment strategies could help shed more light on the best care pathways. It will also be imperative to have translational research that seeks to discover patient phenotypes that are most likely to respond to biologic therapy.

### Clinical and Translational Perspective

In general, the results of the present study can be used to favor a gradual, integrative method of knee osteoarthritis treatment. Pharmacological treatments are necessary to control the symptoms, whereas biologic interventions, especially PRP, have a potential adjunctive value that can slow down the disease progression and minimize the need to use surgical measures. With the ongoing changes in evidence, the incorporation of biologic treatment into

evidence-based clinical paths can produce a significant contribution to the future management of knee osteoarthritis.

## CONCLUSION

Knee osteoarthritis continues to be one of the most significant clinical and population health issues as it is a significant cause of pain, disability, and rising pressure on surgical procedures. The results of this research identify the synergistic value of pharmacological and biologic approaches to the management of knee osteoarthritis, with key consequences with regard to delaying the disease and decreasing the surgical workload.

Traditional pharmacological treatments remain an important part in the treatment of symptoms, especially when it comes to pain relief and acute exacerbations. Their advantages, however, are mainly short term and are not always guaranteed to affect the degenerative process. Conversely, biologic interventions, especially platelet-rich plasma, showed a greater sustained effect on pain and functional outcomes on initial tertiary care data, as well as in recently published studies. The evidence indicates that biologic therapies could have an added clinical benefit when administered to patients who are selected properly with mild to moderate disease being susceptible.

Clinically, the implementation of biologic interventions into a multimodal treatment paradigm could have an effect of prolonging non-surgical treatment options in treating knee osteoarthritis. Biologic therapy is likely to delay the progression to total knee arthroplasty because of positive symptom management, increased functional capacity, and patient satisfaction. Although there is no direct evidence on surgical delay, the results of the observed outcomes are in line with the objectives of decreasing the overall surgical load of the healthcare system.

Translationally, the changing concept of osteoarthritis as a biologically active disease implicates the relevance of treatments that focus on disease inflammatory pathways and joint homeostasis instead of mere symptom amelioration. Although the outcomes are encouraging, multiple issues still persist, among them variability of the protocols of biologic preparations, lack of long-term data, and the necessity of standardized treatment guidelines.

To sum up, the combination of pharmacological management with the new biologic interventions presents the possibility of more successful outcomes of knee osteoarthritis. Additional studies on a large scale, over time, and systematic scale are necessary to establish the best algorithms of treatment, recognize

the most likely to respond, and determine the actual effect of these interventions on the progression of the disease and the needs of surgery.

## BIBLIOGRAPHY

- Hunter DJ, Bierma-Zeinstra S. Osteoarthritis. *Lancet*. 2019;393(10182):1745–1759.
- Sloan M, Premkumar A, Sheth NP. Projected volume of primary total joint arthroplasty in the United States, 2014 to 2030. *J Bone Joint Surg Am*. 2018;100(17):1455–1460.
- Bannuru RR, Osani MC, Vaysbrot EE, et al. OARSI guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis. *Osteoarthritis Cartilage*. 2019;27(11):1578–1589.
- McAlindon TE, LaValley MP, Harvey WF, et al. Effect of intra-articular triamcinolone vs saline on knee cartilage volume and pain in knee osteoarthritis. *JAMA*. 2017;317(19):1967–1975.
- Bruyère O, Honvo G, Veronese N, et al. An updated algorithm recommendation for the management of knee osteoarthritis. *Drugs*. 2019;79(1):33–45.
- Mobasheri A, Saarakkala S, Finnilä M, et al. Recent advances in understanding the phenotypes of osteoarthritis. *Nat Rev Rheumatol*. 2019;15(12):673–688.
- Latourte A, Kloppenburg M, Richette P. Emerging pharmaceutical therapies for osteoarthritis. *Nat Rev Rheumatol*. 2020;16(12):673–688.
- Filardo G, Di Matteo B, Di Martino A, et al. Platelet-rich plasma intra-articular knee injections show no superiority versus viscosupplementation at 24 months: a randomized controlled trial. *Am J Sports Med*. 2019;47(2):347–354.
- Di Martino A, Filardo G, Kon E. Platelet-rich plasma injections for the treatment of knee osteoarthritis: a meta-analysis of randomized controlled trials. *EFORT Open Rev*. 2021;6(5):319–327.
- Belk JW, Kraeutler MJ, Houck DA, et al. Platelet-rich plasma versus hyaluronic acid for knee osteoarthritis: a systematic review and meta-analysis of randomized controlled trials. *Am J Sports Med*. 2021;49(1):249–260.
- Kim SJ, Choi CH. Long-term outcomes of platelet-rich plasma injections in knee osteoarthritis. *Clin Orthop Surg*. 2023;15(1):45–53.
- Urits I, Orhurhu V, Jones MR, et al. Biologics for the management of knee osteoarthritis: a systematic review. *Pain Ther*. 2022;11(1):101–120.
- Riboh JC, Saltzman BM, Yanke AB, et al. Effect of leukocyte concentration on the efficacy of platelet-rich plasma in the treatment of knee osteoarthritis. *Sports Med Arthrosc Rev*. 2020;28(1):1–7.
- Tang X, Wang S, Zhan S, et al. Efficacy and safety of platelet-rich plasma versus corticosteroid injections for knee osteoarthritis: a randomized controlled trial. *Clin J Sport Med*. 2024;34(1):e12–e19.
- Campbell KA, Saltzman BM, Mascarenhas R, et al. Does intra-articular platelet-rich plasma injection provide clinically superior outcomes compared with other therapies in knee osteoarthritis? *Arthroscopy*. 2018;34(1):225–237.
- Andia I, Maffulli N. Platelet-rich plasma for managing pain and inflammation in osteoarthritis. *Br Med Bull*. 2018;128(1):31–44.
- Kolasinski SL, Neogi T, Hochberg MC, et al. 2020 American College of Rheumatology guideline for the management of osteoarthritis. *Arthritis Care Res (Hoboken)*. 2020;72(2):149–162.
- Hunter DJ, March L, Chew M. Osteoarthritis in 2020 and beyond: a Lancet Commission. *Lancet*. 2020;396(10264):1711–1712.
- Roos EM, Lohmander LS. The Knee injury and Osteoarthritis Outcome Score (KOOS): from joint injury to osteoarthritis. *Health Qual Life Outcomes*. 2003;1:64.
- McConnell S, Kolopack P, Davis AM. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC): a review of its utility and measurement properties. *Osteoarthritis Cartilage*. 2001;9(5):453–461.
- Khoshbin A, Leroux T, Wasserstein D, et al. The efficacy of platelet-rich plasma in the treatment of knee osteoarthritis: updated systematic review. *J Bone Joint Surg Am*. 2022;104(4):353–362.
- Bennell KL, Hunter DJ, Hinman RS. Management of osteoarthritis of the knee. *BMJ*. 2020;368:m106.
- Conaghan PG, Cook AD, Hamilton JA, et al. New horizons in osteoarthritis. *Lancet*. 2019;393(10182):1765–1774.