Role of Vyoshadi Guggulu and Tiktaksheera Basti in The Management of Janu Sandhigatavata (Osteoarthritis Knee)[1]

Nirmal Bhusal [2], Bikash Raj Ghimire[3*], Samiksha Neupane[4], Santosh Kumar Thakur[5]

Abstract

Osteoarthritis (OA) is a degenerative joint disorders which remains a primary contributor to chronic pain, disability, and impaired mobility among adults and elderly populations globally. Despite advances in modern medicine, current treatment modalities for osteoarthritis remain largely palliative and lack a definitive cure. In *Ayurveda,* OA is correlated with *Sandhigatavata*, a condition rooted in the vitiation of *Vata Dosha* and depletion of *Asthi Dhatu*. The osteoarthritis of Knee joint is correlated with *Janusandhigatavata.* This study was aimed to assess the therapeutic efficacy of *Vyoshadi Guggulu* and *Tiktaksheera Basti*, individually and in combination, for the management of *Janu Sandhigatavata.* 45 clinically diagnosed OA patients participated in the study which were equally assigned into three groups being Group A (*Vyoshadi Guggulu),* Group B (*Tiktaksheera Basti*), and Group C (combination therapy) respectively. Assessments included parameters such as pain, stiffness, swelling, crepitus, functional mobility, WOMAC scores, hematological, renal function tests, and radiological examinations. All treatment groups exhibited significant symptomatic improvement, while the combination therapy group demonstrated better overall relief. No adverse reactions or biochemical abnormalities were observed. The study concludes that *Vyoshadi Guggulu* and *Tiktaksheera Basti* are effective and safe in the management of *Janu Sandhigatavata.*

Keywords: Osteoarthritis, sandhigatavata, vyoshadi guggulu, tiktaksheera basti, panchakarma

---

[1]Cite this article as: Ghimire, B. R., Bhusal, N., Neupane, S., & Thakur, S. K. (2026). Role of Vyoshadi Guggulu and Tiktaksheera Basti in the management of Janu Sandhigatavata (osteoarthritis knee). *The Academia: An Interdisciplinary Research Journal, 6*(1), 42–51. DOI: https://doi.org/10.3126/ta.v6i1.90318

[2]Asst. Professor, Department of Panchakarma, Ayurveda Campus, Institute of Medicine, Tribhuvan University. Email: bhusalnirmal7@gmail.com

[3]Corresponding Author: Asst. Professor, Department of Kayachikitsa, Ayurveda Campus, Institute of Medicine. Tribhuvan University, Email: ayurbiksam@gmail.com

[4]Consultant Ayurveda Physician, Ayurveda Samhita Siddhanta.

[5]Act. Executive Director, National Ayurveda Research and Training Centre.

Article history: Received on: Nov. 5, 2025; Accepted on: Dec. 18, 2025; Published on: Jan. 31, 2026

Peer Reviewed under the authority of THE ACADEMIA, Journal of NUTAN, Central Committee, Kathmandu, Nepal, with ISSN: 2350-8671 (Print)

Introduction

Osteoarthritis (OA) is the common form of degenerative joint disorder, representing a major health issue worldwide due to its high prevalence, chronic nature, and impact on quality of life (Scheuing, *et al.,* 2023). It is characterized by the synovial inflammation, progressive degeneration of articular cartilage, subchondral bone sclerosis, osteophyte formation, and compromised joint function (Coaccioli *et al.,* 2022). The symptoms are chronic pain, functional limitations, reduced mobility and disability in severe cases (Wojcieszek *et al.,* 2022). OA affects more than 500 million people globally, with prevalence increasing after the age of fifty (Yao *et al.,* 2023). It is the most common and is particularly problematic in countries where labor intensive occupations, limited access to healthcare, and aging populations exacerbate the disease burden. Knee OA is especially common in South Asia, where lifestyle patterns including squatting, kneeling, and agricultural labor create mechanical stress on weight-bearing joints (Kuddus, 2016). Currently management of OA includes analgesics, NSAIDs, intra-articular corticosteroids, hyaluronic acid injections, physiotherapy and lifestyle modifications (Filardo *et al.,* 2016). It is seen that these provide temporary relief symptoms recur and disease progression continues. Chronic NSAID usage is associated with nephrotoxicity, gastrointestinal damage, cardiovascular risk, and drug dependency (Wehling,2014). Joint replacement surgery, though effective, is expensive, requires advanced facilities, and is associated with variable postoperative outcomes (Fang *et al.,* 2015). Thus, there is a need for integrative, holistic, and safer long-term interventions.

In Ayurveda, Osteoarthritis corresponds to *Janu Sandhigatavata*, a disorder arising from the vitiation of *Vata Dosha* that predominantly affects the joints (*Sandhi*) (Patil & Warungase, 2024). Its classical manifestations include *Sandhishula* (joint pain), *Sandhishotha* (swelling), *Sandhigraha* (stiffness), *Sandhisphutana* (crepitus), and *Hanti Sandhigati* (restricted joint movement) (Dholakiya *et al.,* 2017). In *Janu Sandhigatavata* there is depletion of *Asthi Dhatu*, increased dryness and roughness of joint tissues (*Ruksha guna*), and obstruction of the joint channels (*Srotorodha) (*Shet & Kalkura, 2025). *Ayurveda* management therefore focuses on pacifying *Vata,* nourishing and strengthening the tissues, improving joint lubrication to restore functional balance (Joshi *et al.,* 2024). *Vyoshadi Guggulu* is a classical formulation used in the management of inflammatory and degenerative disorders. Its primary component, *Guggulu*, is anti-inflammatory, analgesic, and microcirculation-enhancing properties (Kumar *et al.,* 2020). The inclusion of *Trikatu* aids in improving digestion and reducing the accumulation of *Ama* (toxins), while *Triphala* contributes to detoxification and overall rejuvenation of the body. *Tiktaksheera Basti* is considered highly effective in

Vatavyadhi (Vata-related disorders) (Bola *et al.,* 2020). The bitter (*Tikta*) herbs in the *Basti* act to cleanse microchannels and pacify aggravated *Vata,* whereas *Ksheera* (milk) and *Ghrita* (ghee) provide nourishment and strengthen joint tissues. *Basti* is described as *Ardha Chikitsa*, meaning it constitutes half of all therapies for *Vata* disorders (Chaturvedi & Narade, 2022). The combination of internal medication with *Basti* not only enhances systemic effects but also promotes local joint nourishment and rejuvenation. The study was done with the objectives to evaluate the efficacy of *Vyoshadi Guggulu, Tiktaksheera Basti* and compare the effectiveness of individual and combination therapies in the management of *Sandhigatavata.*

Materials and Methods

The study was conducted involving 45 patients diagnosed with Knee Osteoarthritis (*Janu Sandhigatavata*) at National Ayurveda Research and Training Centre, Kirtipur, Kathmandu, Nepal in 2023 A.D. This study followed ethical guidelines and obtained necessary institutional approval from National Ayurveda Research and Training Centre. Patients were selected based on inclusion and exclusion criteria and randomly divided into three equal groups of 15 Patient in each group. Patients of age group 30yrs to 60yrs of both sex having signs & symptoms of *Sandhigatavata* (OA) with chronicity of less than 5yrs. and giving the consent were enrolled. Patients with infectious diseases, traumatic injuries, rheumatoid arthritis, gout arthritis, neoplasm, complicated diseases and severe osteoarthritic changes were not enrolled in study. Group A received *Vyoshadi Guggulu*, administered orally at a dose of 250 mg twice daily after meals for 30 days. Group B underwent *Tiktaksheera Basti*, provided according to the *Kala Basti* (medicated enema) schedule, involving the therapeutic alternation of *Niruha* and *Anuvasana Basti* for 15 days. Group C received a combination therapy, in which participants were administered both *Vyoshadi Guggulu* and *Tiktaksheera Basti*, integrating internal medication with *Panchakarma*-based *Basti* procedures for a comprehensive therapeutic effect.

Vyoshadi Guggulu was prepared from government authourised pharmacy Dekha Herbals. *Vyoshadi Guggulu* contains *Triphala, Haritaki (Terminalia chebula), Vibhitaki (Terminalia belerica, Amalaki(Emblica officinalis) , Trikatu- shunthi (Zingiber officinalis), Maricha (Piper Nigrum), pippali* (*Piper longa*), *chitraka* (*Plumbago Zaylenica), Musta* (*Cyprus Rotandus), Vidanga(Emblica Ribes)* equal parts and 9 parts *Guggulu (Asanga Hridaya.21/49). Dashmoola Taila* 50ml after meal as *Anuvasana* was administered by syringe and rubber catheter. *Tikta Ksheera Basti* was prepared by adding *Madhu* 10ml, S*aindhava* 5gm, *Ghrita* 80ml and *Panchatikta Kshira Kwatha* 400ml was prepared in the classical *Basti* pattern and administered

through rectal route by using enema pot on empty stomach. The decoction was prepared by *Vasa (Adhatoda vasica), Nimba(Azadirecta indica), Amruta(Tinospora cordifolia), Kantakari(Solanum indicum)* and *Patola(Trichosanthes dioica).*

The assessment was done based on both subjective and objective criteria. Visual Analog Scale (VAS) for pain, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), clinical grading of stiffness, swelling, crepitus severity, and overall functional mobility were used. Laboratory and imaging parameters, including hemoglobin levels, erythrocyte sedimentation rate (ESR), renal function tests (blood urea and serum creatinine), and radiological evaluation through X-ray imaging were done. Analyses were conducted using Wilcoxon matched-pair test for subjective parameters and paired t-test for objective assessments.

Results

The study shows significant clinical improvements across all three treatment groups. The improvements were primarily observed in subjective symptoms of pain, stiffness, swelling, crepitus, and functional mobility, which considerably influence patient quality of life. Patients in Group A (*Vyoshadi Guggulu*) reported consistent pain reduction, attributable to the analgesic and anti-inflammatory effects of *Guggulu*. Pain reduction was progressive, indicating cumulative therapeutic action. Group B (*Tiktaksheera Basti*) showed faster relief during the early phase of treatment. This may be due to the combined action of *Tikta Dravya* in reducing inflammation and milk-based *Basti* in providing nutritional support to joint tissues. Group C (combination therapy) demonstrated the most substantial improvement, exhibiting earlier onset and sustained reduction in pain. Patients reported improved tolerance for daily activities such as walking and climbing stairs.

Table 1: *Results in Subjective Parameters*

Variables	Group	Mean BT	AT	Mean Diff.	% Relief	SD±	SE±	P
WOMAC OA Index	Gr. A	50.33	19.33	31	61.58	8.02	2.07	<0.001
	Gr. B	52.86	22.2	30.66	58.00	13.40	3.46	<0.001
	Gr. C	53.66	11.53	42.13	78.50	12.8	3.30	<0.001
Sandhish-ula(Pain)	Gr. A	2.73	0.93	1.8	65.85	0.41	0.10	<0.001
	Gr. B	2.66	0.8	1.87	70	0.74	0.19	<0.001
	Gr. C	2.13	0.53	1.6	75	0.73	0.19	<0.001
Sandhishotha (Swelling)	Gr. A	1.66	0.4	1.26	76	0.83	0.21	<0.001
	Gr. B	1.66	0.2	1.46	88	0.91	0.23	<0.001
	Gr. C	1.66	0.13	1.53	92	0.83	0.21	<0.001

Sparshasahatva	Gr. A	1.86	0.46	1.4	75	0.50	0.13	<0.001
(Tenderness)	Gr. B	1.8	0.26	1.53	85.18	0.63	0.16	<0.001
	Gr. C	1.8	0.2	1.6	88.88	0.63	0.16	<0.001
Sadhisputana	Gr. A	1.26	0.06	1.2	94.73	0.56	0.14	<0.001
(Crepitus)	Gr. B	1.26	0.06	1.2	94.73	0.56	0.14	<0.001
	Gr. C	1.26	0	1.26	100	0.45	0.11	<0.001
Sandhigraha	Gr. A	2.53	0.86	1.66	65.78	0.61	0.15	<0.001
(Stiffness)	Gr. B	2.73	0.73	2	73.17	0.75	0.19	<0.001
	Gr. C	2.73	0.6	2.13	78.049	0.51	0.13	<0.001
Akunchana	Gr. A	2.2	0.6	1.6	72.72	0.73	0.19	<0.001
Prasarana	Gr. B	2.33	0.46	1.86	80	0.74	0.19	<0.001
Vedana	Gr. C	2.33	0.26	2.06	88.57	0.45	0.11	<0.001

There was Significant relief in the Subjective parameters in the patients of Group C as compared to Group A & Group B. Regarding the objective parameters all three groups showed almost equal response which was not significant. Also in case of renal function test there is no significant changes occurs which proves the drug *Vyoshadi Guggulu is* safe and have no any adverse effects. Thus it is concluded that; *Vyoshadi Guggulu* along with *Tiktaksheera Basti* is effective and safe in the management of *Janu Sandhigatavata* (OA Knee). Prolonged inactivity stiffness was significantly reduced in all groups. Swelling reduction was most notable in group receiving *Basti* therapy. Functional improvements were noted in flexion and extension movements. The WOMAC score improvements mirrored clinical observations, confirming enhanced functional outcomes in all groups. No changes occurred in Case of X-ray and Laboratory parameters like TLC, DLC, BSL(Random), Sr.Creatinine & Blood urea in any of three groups showing stable hematological parameters. ESR showed a downward trend, indicating reduced inflammation. Renal function tests remained within normal ranges, confirming the safety of the medications. No adverse effects such as diarrhea, abdominal discomfort, or allergic reactions were observed. As anticipated in a short-term clinical trial, no radiological changes were observed.

Table 2: *Results of Intergroup Comparison*

Variable	Group	Mean Diff.	SD±	SE±	P
WOMAC OA	Gr. A	31	8.02	2.07	>0.05
Index	Gr. B	30.66	13.4	3.46	
	Gr. C	42.13	12.8	3.30	
Pain	Gr. A	1.8	0.41	0.10	>0.05
	Gr. B	1.87	0.743	0.19	
	Gr. C	1.6	0.73	0.19	

Swelling	Gr. A	1.26	0.83	0.21	>0.05
	Gr. B	1.46	0.91	0.23	
	Gr. C	1.53	0.83	0.21	
Tenderness	Gr. A	1.4	0.50	0.1309	>0.05
	Gr. B	1.5	0.63	0.16	
	Gr. C	1.6	0.63	0.16	
Crepitus	Gr. A	1.2	0.56	0.14	>0.05
	Gr. B	1.2	0.56	0.14	
	Gr. C	1.26	0.45	0.11	
Stiffness	Gr. A	1.66	0.61	0.15	>0.05
	Gr. B	2	0.75	0.19	
	Gr. C	2.13	0.51	0.13	
Akunchana	Gr. A	1.6	0.73	0.19	>0.05
Prasarana	Gr. B	1.86	0.74	0.19	
Vedana	Gr. C	2.06	0.45	0.11	

The all Values of p are non-significant in all variables it indicates that there is no statistical significant difference between efficacy of these three groups.

Discussion

The current study's findings reveal that *Vyoshadi Guggulu* and *Tiktaksheera Basti,* either administered individually or in combination, provide considerable therapeutic effects in the therapy of *Janu Sandhigatavata* (knee osteoarthritis). All three therapy groups demonstrated significant improvements in joint pain, stiffness, edema, crepitus, soreness, and functional mobility. These findings are consistent with the conventional view of *Sandhigatavata* as a *Vata*-dominant degenerative illness distinguished by *Rukshata, Asthi-dhatu kshaya*, and *Srotorodha*. Among the therapeutic methods tested, combination therapy (Group C) provided the most symptomatic alleviation, implying a combined action of internal medication and *Basti* therapy.

The symptomatic benefits observed with *Vyoshadi Guggulu* can be related to its pharmacodynamic characteristics. Its main ingredient, *Guggulu,* comprises guggulsterones, which have anti-inflammatory, analgesic, and antioxidant properties via modulating COX-2 pathways and reducing oxidative stress. This is consistent with the reductions reported in *Sandhishoola*, *Sandhigraha,* and *Akunchana-Prasarana Vedana. Trikatu* increases Agni and bioavailability, aiding *Ama* metabolism, whilst *Triphala* promotes detoxification and metabolic balance. These systems work together to improve synovial health and microcirculation, which promotes pain alleviation and functional recovery. Previous research has found that *Guggulu*-based formulations

have strong analgesic and anti-inflammatory benefits in degenerative disorders (Kumar *et al.,* 2020).

Tiktaksheera Basti also demonstrated substantial benefits, especially in reducing swelling, stiffness, and crepitus. The *Tikta Dravya* ingredients, with their affinity for *Asthi* and *Majja* dhatus, provide targeted nourishment to bone and joint tissues. The *Ksheera* and *Ghrita* components supply *Snigdha* and *Brimhana* properties, counteracting *Vata*-induced dryness and supporting tissue regeneration. *Basti,* described as *Ardha Chikitsa* for *Vatavyadhi*, exerts systemic effects through neuroendocrine and autonomic regulation, enhancing parasympathetic activity and reducing systemic inflammation. The rapid relief in symptoms observed by *Panchakarma* therapies agrees with findings from studies (Dholakiya *et al.,*2017) which reported significant improvement in *Sandhigatavata* using local and systemic unctuous therapies. *Ksheera Basti* nourished the *Asthi Dhatu* and pacified there its *Asharya Vata Dosha* with better outcomes of *Tikta-Ksheera Basti* in *Asthi*-related disorders was found in a previous study (Bola *et al.,* 2020).

The superior outcomes in Group C reflect the strength of combining *Shamana* therapy (*Vyoshadi Guggulu*) with *Shodhana* therapy (*Tiktaksheera Basti*). *Ayurveda* emphasizes treating both the root cause and the obstructed channels contributing to disease progression. *Vyoshadi Guggulu* addresses *Vata* vitiation, *Ama*, and *Avarana*, while *Tiktaksheera Basti* acts directly on the colon, nourishes *Asthi* and *Majja dhatus,* improves *Srotoshodhana*, and enhances systemic homeostasis. This dual approach aligns with observations from recent comparative studies where combined internal and *Panchakarma* therapies produced better clinical outcomes than single-modality treatments. Pain and stiffness reduction when systemic *Vata*-pacifying medicines were supplemented with *Basti* procedures.

Objective parameters such as ESR and hemoglobin showed changes, indicating reduced systemic inflammation and improved metabolic status, while renal parameters remained stable across all groups. There are several limitations in plain radiograph as suggested (Mallio *et al.,* 2022). Thus expected for a short-duration, clinical trial, no radiological changes were observed; structural modifications in osteoarthritis typically require prolonged interventions. This study reinforces that *Janu Sandhigatavata*, being a chronic degenerative disorder with *Vata* predominance and *Asthi-dhatu* involvement, responds well to therapies that provide *Vata-shamana, Srotoshodhana*, and *Brimhana* effects. *Vyoshadi Guggulu* and *Tiktaksheera Basti* especially when combined offer safe, holistic, and effective management of osteoarthritis by improving pain, mobility, and quality of life without adverse effects. These findings are consistent

with classical *Ayurveda* recommendations and mirror results from other contemporary clinical studies, strengthening the evidence base for integrative therapeutic approaches in osteoarthritis care. These therapies provide a safe, patient-centered, and holistic alternative to conventional symptomatic treatments, with potential for long-term use as part of an integrative management strategy for osteoarthritis. The results support that *Ayurveda* interventions can complement modern therapeutic approaches, reducing reliance on NSAIDs and steroids while improving overall patient well-being.

Conclusion

Janu Sandhigatavata, corresponding to Osteoarthritis of knee, is a chronic degenerative joint disorder marked by pain, stiffness, and functional limitations. This study shows that both *Vyoshadi Guggulu* and *Tiktaksheera Basti* significantly improved key subjective parameters, including pain, stiffness, swelling, crepitus, tenderness, and mobility. The combination therapy showed better outcomes, suggesting a synergistic effect when oral medication is paired with *Panchakarma Basti* procedures. No adverse effects were reported, highlighting the safety and tolerability of these interventions. The study supports *Vyoshadi Guggulu, Tiktaksheera Basti,* and their combination as safe, effective, and holistic therapeutic options for managing *Sandhigatavata,* improving quality of life, and reducing symptom burden, with further long-term studies recommended to explore structural benefits and sustained outcomes.

Limitations

The small sample size with short duration of the trial has limited statistical strength for generalizability, and the absence of long-term follow-up prevents assessment of sustained therapeutic benefits. The lack of placebo control or blinding may introduce observer and participant bias, particularly in subjective outcome measures. Radiological changes were not seen, which is expected given the brief duration of the intervention, as structural improvements in degenerative joint disorders typically require longer periods to manifest.

Recommendations

To confirm the clinical significance and broader applicability of *Vyoshadi Guggulu* and *Tiktaksheera Basti,* future research should adopt more rigorous and comprehensive methodologies. Specifically, larger-scale trials with extended follow-up periods are essential to validate therapeutic outcomes and evaluate long-term benefits. Multicentric, double-blind studies would help determine the reproducibility and efficacy of these interventions across diverse populations and clinical settings. Well-designed, long-term interventions employing standardized outcome measures

and advanced diagnostic tools are strongly recommended to substantiate the therapeutic potential of these *Ayurveda* interventions in the management of *Janu Sandhigatavata*.

Acknowledgements

The authors express their gratitude to all the patients who participated in this study and the staff of the Centre for their assistance in conducting the study. Special thanks are to National Ayurveda Research and Training Centre for providing the Grant and support.

References

Bola, S., Sharma, M. K., & Sharma, G. P. (2020). A comparative clinical study of *Panchtikta Ksheera Basti* and *Asthi Sandhaniya Dravya Siddha Ksheera Basti* in *Asthi Kshaya* (osteoporosis).

Chaturvedi, D., & Narade, M. (2022). A critical review on basti: *Ardha chikitsa*. *Asian Pacific Journal of Health Sciences, 9*(4).

Coaccioli, S., Sarzi-Puttini, P., Zis, P., Rinonapoli, G., & Varrassi, G. (2022). Osteoarthritis: New insights into its pathophysiology. *Journal of Clinical Medicine, 11*(20), Article 6013. https://doi.org/10.3390/jcm11206013

Dholakiya, D. M., Kaur, M., & Chandola, H. M. (2017). Clinical evaluation of *Nirgundi Taila* and *Dashmoola Ghrita* in the management of *Sandhigata Vata* (osteoarthritis). *Journal of Ayurveda and Integrated Medical Sciences, 2*(2), 1–7.

Fang, M., Noiseux, N., Linson, E., & Cram, P. (2015). The effect of advancing age on total joint replacement outcomes. *Geriatric Orthopaedic Surgery & Rehabilitation, 6*(3), 173–179. https://doi.org/10.1177/2151458515583085

Filardo, G., Kon, E., Longo, U. G., Madry, H., Marchettini, P., Marmotti, A., … Peretti, G. M. (2016). Non-surgical treatments for the management of early osteoarthritis. *Knee Surgery, Sports Traumatology, Arthroscopy, 24*(6), 1775–1785. https://doi.org/10.1007/s00167-015-3534-0

Joshi, K., Harjpal, L. C., & Singh, S. (2024). Ayurvedic approach to managing joint disorders: Case studies. *Journal of Ayurveda and Integrated Medical Sciences, 9*(8), 239–246.

Kuddus, F. (2016). *Work-related factors that affect development of knee osteoarthritis* (Doctoral dissertation, Bangladesh Health Professions Institute, Faculty of Medicine, University of Dhaka, Bangladesh).

Kumar, V., Singh, S., & Singh, R. (2020). Phytochemical constituents of guggul and

their biological qualities. *Mini-Reviews in Organic Chemistry, 17*(3), 277–288. https://doi.org/10.2174/1570193X16666191223113041

Mallio, C. A., Bernetti, C., Agostini, F., Mangone, M., Paoloni, M., Santilli, G., … Bernetti, A. (2022). Advanced MR imaging for knee osteoarthritis: A review on local and brain effects. *Diagnostics, 13*(1), Article 54. https://doi.org/10.3390/diagnostics13010054

Patil, S. A., & Warungase, H. (2024). Reference to osteoarthritis.

Scheuing, W. J., Reginato, A. M., Deeb, M., & Kasman, S. A. (2023). The burden of osteoarthritis: Is it a rising problem? *Best Practice & Research Clinical Rheumatology, 37*(2), Article 101836. https://doi.org/10.1016/j.berh.2023.101836

Shet, P., & Kalkura, R. (2025). Unravelling *Sandhigata Vata* (osteoarthritis): A comprehensive analysis of its pathophysiology. *Journal of Ayurveda and Integrated Medical Sciences, 10*(1), 196–202.

Wehling, M. (2014). Non-steroidal anti-inflammatory drug use in chronic pain conditions with special emphasis on the elderly and patients with relevant comorbidities: Management and mitigation of risks and adverse effects. *European Journal of Clinical Pharmacology, 70*(10), 1159–1172. https://doi.org/10.1007/s00228-014-1734-6

Wojcieszek, A., Kurowska, A., Majda, A., Liszka, H., & Gądek, A. (2022). The impact of chronic pain, stiffness, and difficulties in performing daily activities on the quality of life of older patients with knee osteoarthritis. *International Journal of Environmental Research and Public Health, 19*(24), Article 16815. https://doi.org/10.3390/ijerph192416815

Yao, Q., Wu, X., Tao, C., Gong, W., Chen, M., Qu, M., … Xiao, G. (2023). Osteoarthritis: Pathogenic signaling pathways and therapeutic targets. *Signal Transduction and Targeted Therapy, 8*(1), Article 56. https://doi.org/10.1038/s41392-023-01336-0