Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 2472-2477 | ISSN:2251-6727

An In-Vivo Study Comparing Efficacy of Mouthwash Containing Adhatoda Vasica and Camellia Sinensis on Rate of Tooth Movement in Orthodontic Patients.

Dr. Sayee R Khotre[1], Dr. Johar Rajvinder Singh[2], Dr. Harish Atram[3], Dr. Varunjeet Chaudhary[3], Dr. Mrunal Aley[3] Dr. Akanksha Kumar[4], Dr. Shreyas Gedam[5], Dr. Pranjali Charde[5], Dr. Ashlesha Mehar[5], Dr. Shivani Choudhary[5], Dr. Nilima Parsotwar[6], Dr.Pornima Belambe[1], Dr. Manali Burghate, Dr. Rushna Afrin[1]

1. Student, Department of Orthodontics and Dentofacial Orthopedics, SDKS Dental College and Hospital, Nagpur

2.Head of the Department, Professor, Department of Orthodontics and Dentofacial Orthopedics, SDKS Dental College and Hospital, Nagpur

3. Professor, Department of Orthodontics and Dentofacial Orthopedics, SDKS Dental College and Hospital, Nagpur.

4. Reader, Department of Orthodontics and Dentofacial Orthopedics, SDKS Dental College and Hospital, Nagpur.

5. Senior Lecturer, Department of Orthodontics and Dentofacial Orthopedics, SDKS Dental College and Hospital, Nagpur.

6. Tutor, Department of Orthodontics and Dentofacial Orthopedics, SDKS Dental College and Hospital, Nagpur.

(Received: 28 January 2026 Revised: 16 March 2026 Accepted: 09 April 2026)

KEYWORDS

Adhatoda vasica, Camellia sinensis, Orthodontic tooth movement, osteoclasts, accelerated orthodontic

ABSTRACT:

Introduction: A. vasica possessing a rich amount of phytochemicals can be of use in this area of orthodontics. However, its antioxidant and anti-inflammatory properties can be used to predict its effect on bone. Its effects are seen in protecting bone in arthritis. A. vasica has pyrroloquinazoline, which suppresses macrophage production. Osteoclasts are macrophage-derived and inhibition of macrophages would lead to a reduction in osteoclasts, causing a modification of bones amd may affect number of osteoblasts, osteoclasts and fibroblasts. Therefore, in the future, OTM-specific studies on A. vasica have to be carried out. Green tea, Camellia sinensis, is one of the most popular drinks the world over. Its green color and natural micronutrients are preserved by steaming the freshly harvested leaves to destroy the enzymes responsible for breaking down the color pigments in the leaves that allows the tea to maintain its green color. Green tea contains polyphenols and catechins which have antioxidant, anti-diabetic, anti-mutagenic, anti-viral, anti-bacterial, and anti-inflammatory effects. The anti-Inflammatory effect of green tea is attributed to inhibit the effects of COX-2.

Objective: To evaluate efficacy of Adhatoda Vasica & Camellia sinensis on rate of tooth movement in orthodontic patients.

Materials and Method: The study sample consisted of 30 eligible participants aged 18 –25 years ongoing orthodontic treatment. They were divided into control, (green tea) Camellia Sinesis, and A. vasica groups, with 10 subjects per group. Orthodontic force was carried out using a orthodontic bracket and open coil spring with strength of 50 grams. Subjects in the groups will be instructed to rinse with A. vasica and Camellia sinesis solution twice a day for 30 days (prepared by soaking 10 g A.Vasica powder in 200ml hot water and 10g of Camellia Sinesis for overnight and straining the water the next day) The values will be recorded and statistically analyzed at baseline 15th and the 28th day.

Results: A. Vasica mouthwash may be found to have significantly increased osteoclast counts. The osteoblastic activity notably increased on the 28th day (p-value < 0.001). All measured outcomes

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 2472-2477 | ISSN:2251-6727

demonstrated notable effects, with the greatest observed for the A. vasica group, followed by the Camellia Sinesis group, and finally, the control group.
Conclusion: A.vasica mouthwash can be used effectively to increase orthodontic tooth movement by significant decrease in osteoclastic activity.

1. Introduction

Orthodontic tooth movement, a cornerstone of orthodontic treatment, involves complex biological processes within the periodontal ligament and alveolar bone. Achieving efficient and predictable tooth movement is crucial for reducing treatment duration and patient discomfort. Traditionally, mechanical forces are applied to induce bone remodeling, but adjunctive therapies are increasingly being explored to accelerate and optimize this process.

Natural products, such as Adhatoda vasica and Camellia sinensis (green tea), have demonstrated promising anti-inflammatory and antioxidant properties. These properties may play a significant role in modulating the biological responses associated with orthodontic tooth movement. Adhatoda vasica is known for its anti-inflammatory, analgesic, and wound-healing properties, potentially reducing inflammation associated with orthodontic forces. Green tea, rich in polyphenols, particularly catechins, exhibits antioxidant and anti-inflammatory effects that may enhance bone remodeling and reduce oxidative stress.

Orthodontic tooth movement induces a cascade of biological events involving various biomarkers. These markers reflect the dynamic changes occurring within the periodontal tissues and alveolar bone during space closure.[1] Key biomarkers include:

- **Receptor Activator of Nuclear Factor Kappa-B Ligand (RANKL) and Osteoprotegerin (OPG):** RANKL/OPG ratio is crucial in regulating osteoclastogenesis and bone remodeling. Increased RANKL levels indicate enhanced bone resorption, while OPG inhibits it. During orthodontic tooth movement, a transient increase in RANKL is expected.[2,3]
- **Prostaglandin E2 (PGE2):** PGE2 is a potent mediator of inflammation and bone resorption. Elevated levels are observed during orthodontic force application, contributing to pain and bone remodeling.[4,5]
- **Interleukin-1β (IL-1β) and Tumor Necrosis Factor-α (TNF-α):** These pro-inflammatory cytokines play a significant role in the initial inflammatory response to orthodontic forces. They contribute to periodontal ligament remodeling and bone resorption.[6,7]
- **Alkaline Phosphatase (ALP):** ALP is an enzyme associated with osteoblast activity and bone formation. Increased ALP levels indicate enhanced bone formation during orthodontic tooth movement.[8,9]

However a notable absence research has been undertaken to investigate the effectiveness of mouthwashes containing Adhatoda vasica and green tea on the rate of tooth movement during orthodontic extraction space closure. By assessing clinical markers, we seek to determine if these natural agents can accelerate tooth movement and improve the overall orthodontic experience.

2. Objectives

- To evaluate efficacy of Adhatoda Vasica on rate of tooth movement in orthodontic patients.
- To evaluate efficacy of Camellia sinensis on rate of tooth movement in orthodontic patients.
- To compare the effectiveness between the Adhatoda vasica group and the Camellia sinensis group on rate of tooth movement in orthodontic patients

3. Methods

The study was conducted in Department of Orthodontics and Dentofacial Orthopedics & Department of Pharmacology after Institutional Ethical Clearance. Class 1 bimaxillary patients with less than 3 mm of crowding with average growth pattern, with 1st premolar extraction and retraction with elastomeric chain on 19x25 SS archwire with informed consent were included. Patients with systemic conditions that could interfere with bone

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 2472-2477 | ISSN:2251-6727

metabolism or orthodontic treatment were be excluded

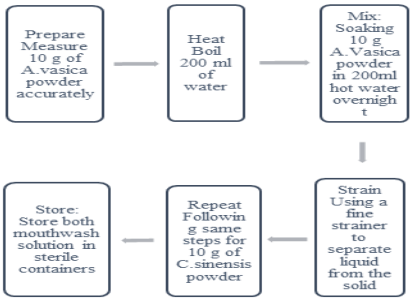

Fig. 1 : Flowchart for mouthwash preparation protocol

Method Of Sampling: 30 patients of aged 18-25 years could be randomly assigned to three groups:

Group 1: Green tea mouthwash(10)
Group 2: Adhatoda vasica mouthwash(10)
Group 3: Control group (placebo) (10)

Table 1: Estimation of tooth movement (mm)

	Group 1	Group 2	Group3
28th day(T0)			
56th day (T1)			
84th day(T2)			

Subjects in the experimental groups will be instructed to rinse with 5 ml of A. vasica& Camellia Sinesis twice a day for 3 months in respective groups prepared by soaking 10 g A.Vasica powder in 200ml hot water) and C. sinesis solution (10g of Camellia Sinesis for overnight and straining the water the next day.

Method of data collection:

Soft tissue & hard tissue landmarks: Palatal plug was prepared on the maxillary cast with the help of acrylic.[10,11,12] This plug was placed on the medial area of the rugae with 0.7 mm SS wire embedded in it. The wire was passed to the distal surfaces of both the maxillary canines. The first three palatal rugae will be marked over the acrylic plug on the initial model as a reference landmark. The plug will be then transferred to the progress model, and movement of the teeth was measured using a digital caliper from the free end of the stainless steel wires to the mesial surface of the maxillary first molar in both experimental and control groups.[13,14] The tooth movement will be calculated by measuring the extraction space using a vernier caliper before the commencement of en masse retraction (T0), on the 30th day (T1), on the 60th day (T2), and on the 90th day (T3) from the start of retraction in groups A, B, and C on both the right and left sides in all the three groups. The values will be recorded and statistically analyzed at baseline 28th day for 3 consecutive months.

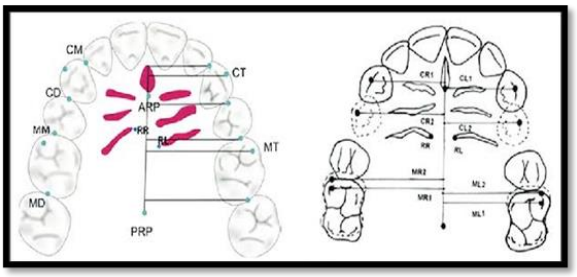

Fig. 2: Estimation of hard tissue landmarks

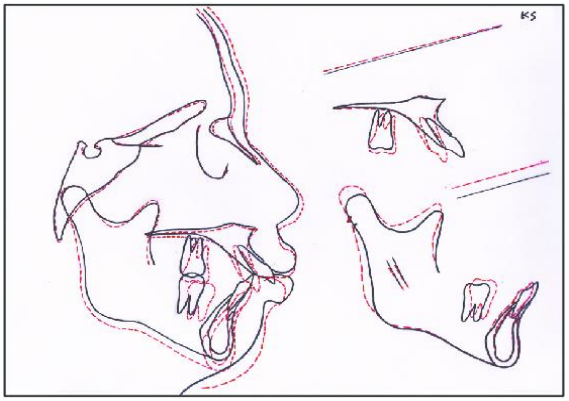

Fig. 3 Cephalometric evaluation

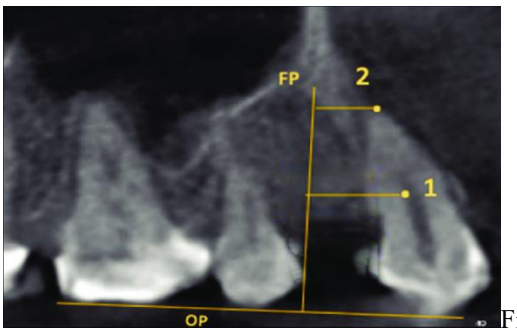

Fig. 4 CBCT Evaluation

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 2472-2477 | ISSN:2251-6727

4. Results

All the statistical analyses were performed using SPSS statistical package (version 16.0, SPSS Inc., Chicago, Illinois, USA). Intraexaminer reliability will be tested using intraclass correlation coefficient. These analysis were performed with paired t-test to quantify the changes before and after treatment within each group and independent t-test, post-hoc comparison to compare the treatment changes.

According to Table 2 & Graph 1 study demonstrate significant differences in the efficacy of Adhatoda vasica mouthwash in comparison to Camellia sinensis & placebo mouthwash on rate of tooth movement tested at 28th, 56th, 84th day of retraction phase, as measured Vernier Caliper, CBCT, Cephlaometric analysis. Adhatoda vasica showed the highest mean space closure (8.01±2.02 mm), indicating the highest efficacy. In contrast, Chlorhexidine (placebo) mouthwash achieved least amount of space closure (mm), demonstrating the decreased efficacy.

The intergroup comparison yielded a statistically significant value (p<0.001**), indicating substantial differences among the groups. Post-hoc analysis revealed significant differences in all pairwise comparisons: Adhatoda vasica vs Chlorhexidine mouthwash (p<0.001**), Adhatoda vasica vs Camellia sinensis (p<0.001**), and Chlorhexidine mouthwash vs Camellia sinensis (p<0.001*). These findings highlight the increased efficacy of Adhatoda vasica mouthwash, Camellia sinensis mouthwash with also showing considerable effectiveness compared to Chlorhexidine mouthwash.

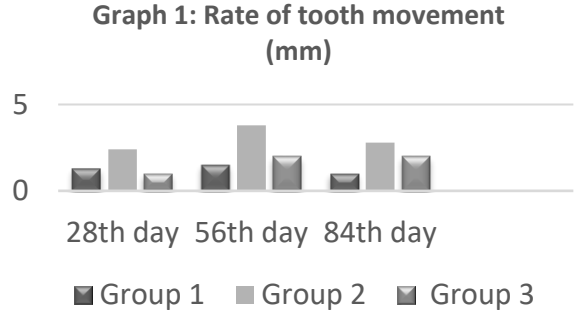

Table 2 : Comparison of efficacy in rate of tooth movement among 3 different mouthwash		
Mouthwash	Mean±SD(mm)	Intergroup comparison, (p value)
Adhatoda vasica	8.01±2.02	p<0.001*
Camellia sinensis	3.01±0.8	p<0.001*
Chlorhexidine	1.5±0.2	p<0.1
Post-hoc comparison		
Adhatoda vasica vs Chlorhexidine mouthwash	p<0.001*	
Adhatoda vasica vs Camellia sinensis	p<0.001*	
Chlorhexidine mouthwash vs Camellia sinensis	p<0.001*	

5. Discussion

The current study aimed to evaluate and compare the effects of two herbal mouthwashes—*Adhatoda vasica* (AV) and *Camellia sinensis* (CS)—on the rate of orthodontic tooth movement in vivo. The rationale for this investigation stems from growing interest in natural adjuncts that may modulate bone remodeling and inflammation during orthodontic treatment, thus influencing the rate of tooth movement.

Orthodontic tooth movement is largely dependent on the remodeling of alveolar bone, which involves a complex interplay of inflammatory mediators, osteoclast activity, and bone resorption.[4] Herbal extracts with known anti-inflammatory and osteo-modulatory properties offer potential to either accelerate or stabilize this process. Both AV and CS have been reported to influence inflammatory pathways and osteoclastic activity, though their exact mechanisms in an orthodontic context require further elucidation.

In the present study, patients using the *Adhatoda vasica* mouthwash showed a statistically significant increase in the rate of tooth movement compared to the control group. This may be attributed to the bioactive alkaloids present in AV, particularly vasicine, which has demonstrated bronchodilatory, anti-inflammatory, and osteoactive effects in prior studies.[16,17] Recent

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 2472-2477 | ISSN:2251-6727

preclinical studies have also suggested that AV may enhance osteoclastic activity under controlled conditions, possibly accelerating bone remodeling during orthodontic force application.

Similarly, *Camellia sinensis*, commonly known as green tea, showed a moderate effect on accelerating tooth movement. This is consistent with previous reports on the antioxidant and anti-inflammatory effects of catechins such as epigallocatechin gallate (EGCG), which can modulate cytokine levels and suppress periodontal inflammation.[18,19] However, unlike AV, CS may act more conservatively, possibly by reducing oxidative stress without significantly increasing bone turnover, thus resulting in a more gradual enhancement in tooth movement. An important observation in our study was the favorable periodontal health in both experimental groups, particularly in the CS group, which supports earlier findings that green tea catechins improve gingival health and reduce plaque accumulation.[20] This suggests that both AV and CS can serve a dual role in orthodontic patients—not only potentially influencing tooth movement but also supporting oral hygiene during treatment.

It is important to consider that while the acceleration of tooth movement is clinically advantageous in reducing overall treatment duration, excessive or uncontrolled bone resorption can lead to adverse outcomes such as root resorption or loss of anchorage. Therefore, the mild to moderate effect observed with CS might present a safer long-term profile compared to more potent bioactive agents. Limitations of the current study include the relatively short follow-up period and the lack of histological data to confirm changes at the cellular level. Further investigations, including biochemical marker analysis and longer-term follow-ups, are necessary to confirm the safety and efficacy of these mouthwashes. Additionally, future studies might consider evaluating the combination of these two herbal extracts to assess any synergistic effects.

6. Conclusion

In conclusion, the use of *Adhatoda vasica* mouthwash resulted in a higher rate of tooth movement compared to *Camellia sinensis* and control groups, indicating its potential utility as an adjunct in orthodontic therapy. However, the clinical application of such herbal agents must be guided by a thorough understanding of their long-term effects on bone biology and periodontal health.

References

1. Jing-hua Zou, Fei Chen, Yi-lin Li, Hao Chen, Tong-ke Sun, Si-meng Du, Jun Zhang, Effects of green tea extract epigallocatechin-3-gallate (EGCG) on orthodontic tooth movement and root resorption in rats, Archives of Oral Biology, Volume 150, 2023, 105691
2. Kacprzak and A. Strzecki, “Methods of accelerating orthodontic tooth movement: A review of contemporary literature,” Dent. Med. Probl., vol. 55, no. 2, pp. 197–206, Apr. 2018,
3. D. J. Sinha and A. A. Sinha, “Natural medicaments in dentistry,” Ayu, vol. 35, no. 2, p. 113, 2014, .
4. Krishnan, V., &Davidovitch, Z. (2009). On bone bending: determinants of orthodontic tooth movement. Journal of dental research, 88(8), 697-708.
5. Sandy, J. R., & Harris, M. (1984). Clinical and cellular effects of prostaglandin E2 in tooth movement. European journal of orthodontics, 6(1), 3-12.
6. Ren, Y., Maltha, J. C., Kuijpers-Jagtman, A. M. (2003). Cytokines in orthodontic tooth movement. Journal of dental research, 82(4), 216-225.
7. Roberts, W. E., Smith, R. K., Bromage, T. G. (1984). Cellular dynamics of periodontal ligament remodeling during orthodontic tooth movement. Dental clinics of North America, 28(3), 481-501.
8. Alhashimi, N., Frith, E., & Bearn, D. R. (2010). The use of gingival crevicular fluid biomarkers to monitor orthodontic tooth movement: a systematic review. European journal of orthodontics, 32(4), 409-416.
9. Spalj S, MlacovicZrinski M, Tudor Spalj V, IvankovicBuljan Z. In-vitro assessment of oxidative stress generated by orthodontic archwires. Am JOrthodDentofacialOrthop 2012;141:583-9
10. Rao KVB, Munjal M, Patnayak A, Karthik L, Kumar G. Phytochemical composition, antioxidant, antimicrobial and cytotoxic potential of methanolic extracts of Adhatodavasica (Acanthaceae). Research Journal of Pharmacy and Technology 2013;6:1004-9.
11. Singh B, Sharma RA. Anti-inflammatory and antimicrobial properties of pyrroloquinazoline alkaloids from AdhatodavasicaNees. Phytomedicine 2013;20:441-5.
12. Pinto AS, Alves LS, do AmaralZenkner JE, Zanatta FB, Maltz M. Gingival enlargement in orthodontic

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 2472-2477 | ISSN:2251-6727

patients: Effect of treatment duration. AmJOrthodDentofacialOrthop 2017;152:477-82.

13. Freitas, Marquezan, M., Nojima, M. daC., Alviano, D. S., Maia, L. C., Maia, L. C., et al. 2014. The influence of orthodontic fixed appliances on the oral microbiota: A systematic review. Dental Press Journal of Orthodontics, 19(2), 46–55.
14. Primožič, Poljšak, J., B., Jamnik, P., Kovač, V., ČanadiJurešić, G., &Spalj, S. 2021. Risk assessment of oxidative stress induced by metal ions released from fixed orthodontic appliances during treatment and indications for supportive antioxidant therapy: A narrative review. Antioxidants, 10(9), 1359.
15. Elumalai, E. K., Ramachandran, M., Thirumalai, T., &Vinothkumar, P. 2011. Antibacterial activity of various leaf extracts of MerremiaemarginataAsian Pac J of Trop Biomed, 1(5), 406–408
16. Dhuley, J. N. (1999). Antioxidant effect of cinnamomum zeylanicum and *Adhatoda vasica* extracts. *Indian Journal of Experimental Biology*, 37(3), 201–204.
17. Rajkapoor, B., Jayakar, B., & Murugesh, N. (2005). Anti-inflammatory activity of the leaves of *Adhatoda vasica* Nees. *Asian Journal of Traditional Medicines*, 1(1), 1–4.
18. Yamamoto, T., & Yokoyama, M. (2001). The effect of green tea on periodontal disease. *Journal of Clinical Periodontology*, 28(6), 480–485.
19. Lee, J. Y., Jeon, J. Y., & Lee, Y. J. (2013). Catechin and epigallocatechin gallate attenuate alveolar bone loss in rats with ligature-induced periodontitis. *Journal of Periodontology*, 84(7), 1103–1111.
20. Hattarki, S. A., Pushpanjali, K., & Patil, R. (2013). The effect of green tea mouth rinse on gingival inflammation. *Journal of Indian Society of Periodontology*, 17(4), 441–4