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Gene Therapy In Periodontics: A Cross-Sectional Survey

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Abstract

Gene therapy is an innovative approach that modifies or introduces genetic material to treat or prevent diseases and shows great promise in periodontics for regenerating tissues like cementum, periodontal ligament, and alveolar bone. This cross-sectional online survey, conducted among 1a08 dental professionals (BDS and MDS) over two months (September–October 2025), assessed their awareness and attitudes toward gene therapy in periodontics using a 26-item questionnaire. Most respondents were BDS students (87%) with less than two years of experience (73.6%). A majority correctly defined gene therapy (71.3%), identified oncology as its first field (73.1%), and recognized viruses (32.4%) and liposomes (53.7%) as common vectors. Regeneration of periodontal tissues (68.5%) was seen as the main benefit, while ethical concerns, cost, and safety were major barriers. Although 75% believed gene therapy remains experimental, 62% showed interest in learning, and 65.7% supported its inclusion in the dental curriculum. Overall, dental professionals demonstrated moderate knowledge but positive attitudes, emphasizing the need for increased education, awareness, and research to support its future clinical use.

Keywords: Gene therapy, periodontics, awareness, dental professionals, tissue regeneration, regenerative dentistry.

Introduction

Gene therapy is an emerging biomedical approach that involves the modification or introduction of genetic material into cells to treat or prevent disease[1]. Initially explored in the field of oncology[2], it has gradually expanded into several areas of medicine, including dentistry[3, 4]. In periodontics, gene therapy holds the potential to revolutionize treatment by promoting regeneration of periodontal tissues such as cementum, periodontal ligament, and alveolar bone[5, 6], which are often irreversibly damaged in periodontal disease[7].

Despite promising advances in preclinical studies[8, 9], the clinical application of gene therapy in dentistry remains limited[10]. Challenges such as vector safety[11], cost[12], ethical concerns[13], and lack of awareness among dental professionals[14] have slowed its integration into practice. Understanding the knowledge, perceptions, and concerns of dental practitioners is crucial, as they will play a central role in adopting and recommending such advanced therapies to patients[15, 16].

This survey was designed to assess the level of awareness, perceptions, and attitudes of dental professionals toward gene therapy in periodontics[17], with the aim of identifying knowledge gaps and highlighting areas for future education and research[18].

Materials and Methods

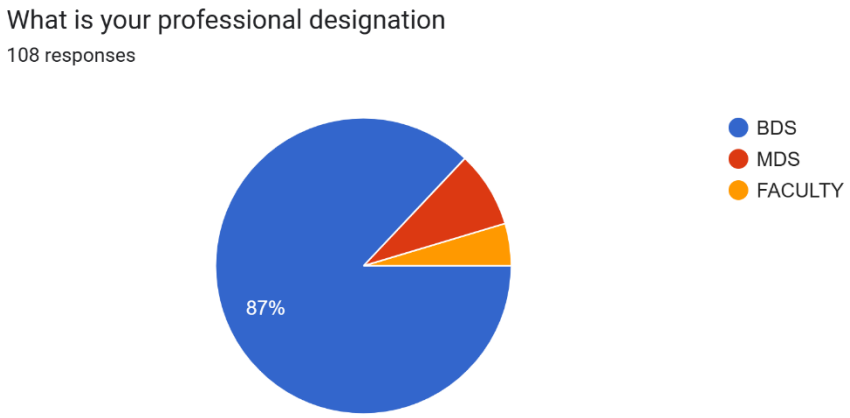
A cross-sectional questionnaire survey was conducted in September 2025 among dental professionals (BDS and MDS) to assess knowledge and perceptions of gene therapy in periodontics over a time period of 2 months. A structured Google Forms questionnaire containing 26 items on demographics, basic concepts, delivery methods, applications, and ethical concerns was distributed electronically. Participation was voluntary with informed consent obtained online. Responses (108) were collected, exported to Microsoft Excel, and analysed using descriptive statistics.

Statistical Analysis

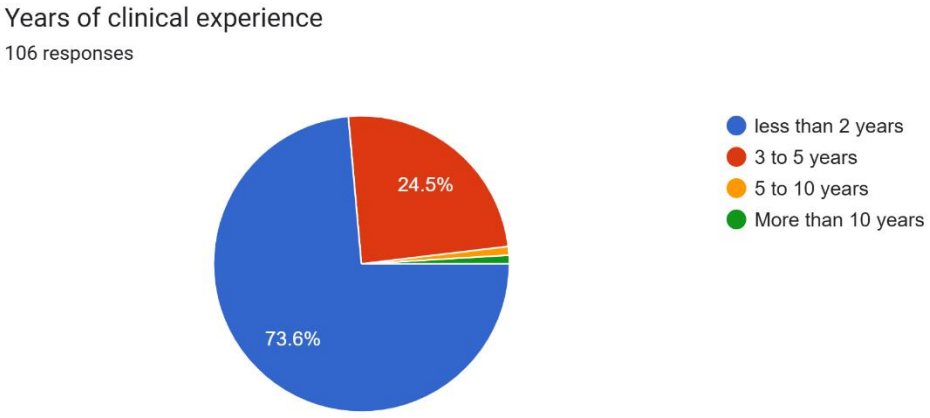
Data were entered in Microsoft Excel and analysed using IBM SPSS Statistics version 29.0 (IBM Corp., Armonk, NY). Descriptive statistics were expressed as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test. the association between professional designation and knowledge level yielded a Chi-square value of 3.69 with 6 degrees of freedom ($p = 0.718$), indicating no significant relationship.

Result

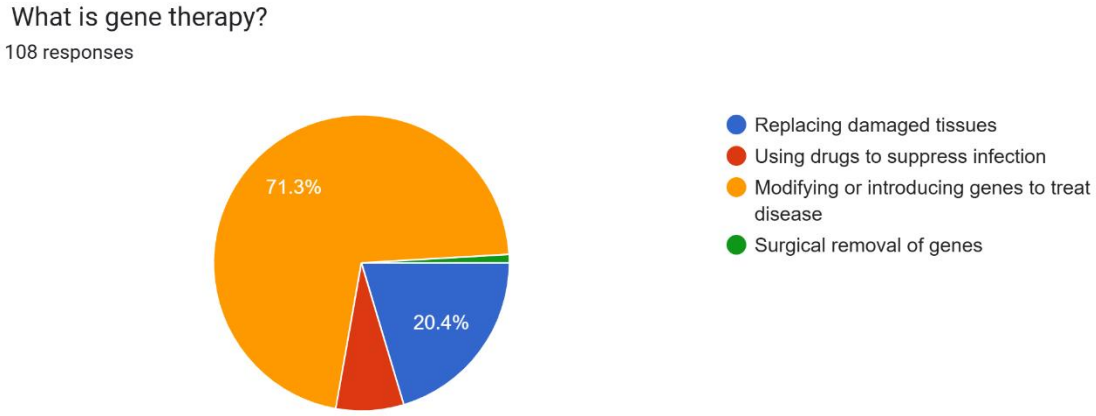
Out of 108 respondents, most were BDS students (87%) with less than 2 years of experience (73.6%). A majority (71.3%) correctly defined gene therapy, and 73.1% identified oncology as its first field. Viruses (32.4%) were the most chosen vectors, and 53.7% correctly identified liposomes as a non-viral delivery method. Regeneration of periodontal tissues (68.5%) was seen as the major advantage, and 60.2% felt gene therapy could serve multiple purposes in periodontics. Most (75%) believed it is still experimental, though 59.3% had heard of its dental use and 49.1% were aware of clinical trials. Interest in learning was high (62%), with 54.6% believing it could replace surgery and 50.9% considering it safe. Somatic gene therapy (46.3%) and direct site injection (34.3%) were preferred. Ethical concerns (57.4%) and challenges like cost, safety, and awareness (61.1%) were major limitations. Overall, 65.7% supported its inclusion in the undergraduate curriculum, and 54.6% reported a moderate level of knowledge.



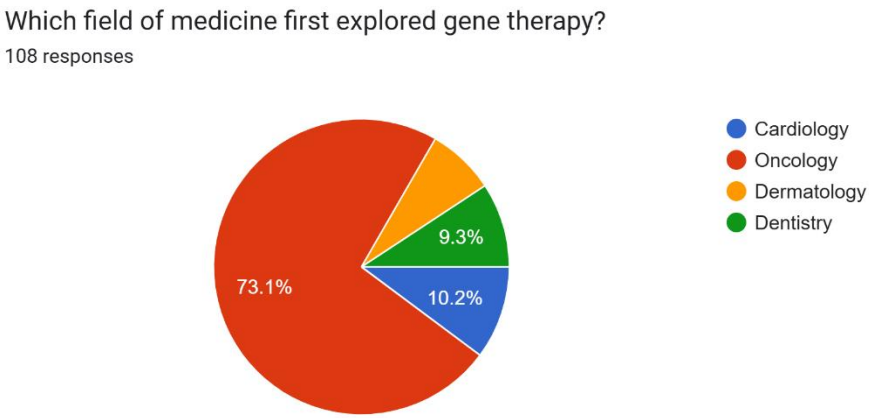
Out of 108 respondents, 87% were BDS students, while 8% were MDS and 5% were faculty members.



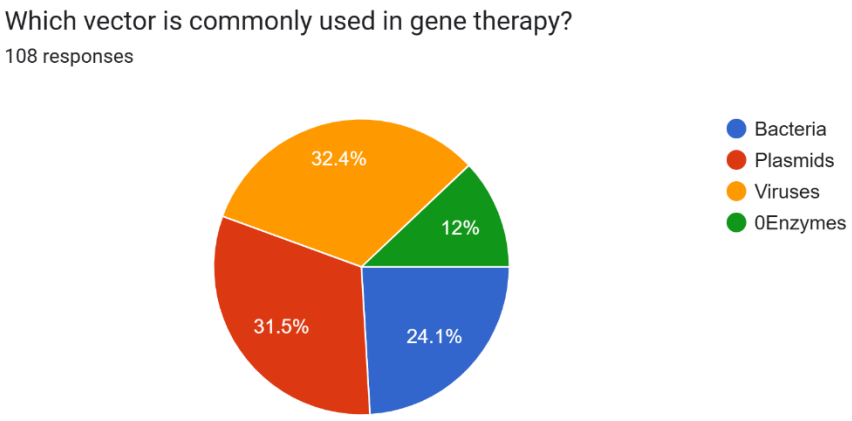
Out of 108respondents, 73.6% had less than 2 years of clinical experience, 24.5% had 3–5 years, while only a small fraction had 5–10 years or more than 10 years of experience.



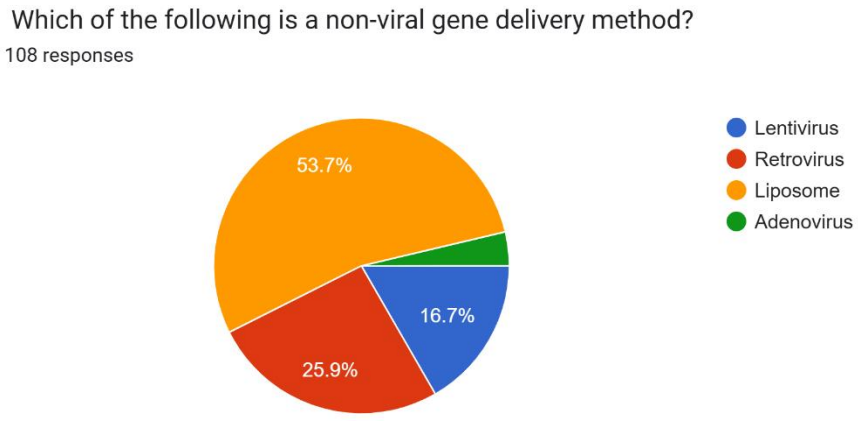
Out of 108 respondents, 71.3% correctly identified gene therapy as modifying or introducing genes to treat disease, while 20.4% thought it was replacing damaged tissues, and only a few selected other options.



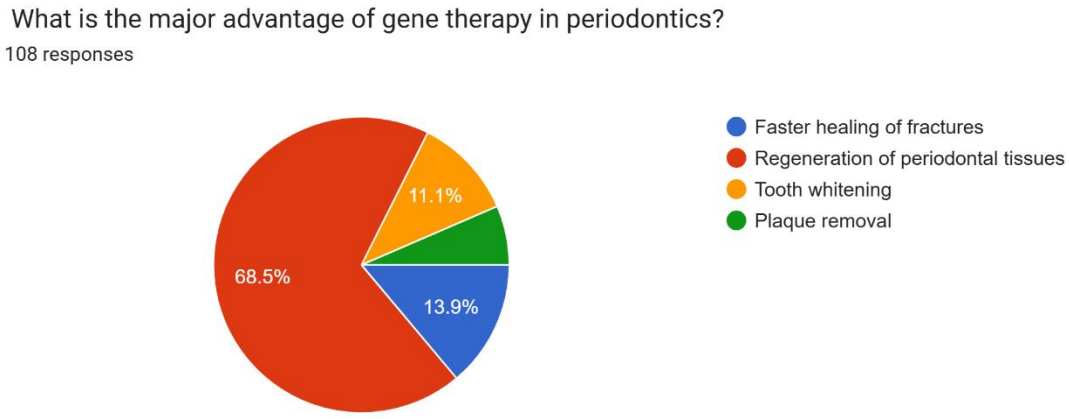
Out of 108 respondents, the majority (73.1%) identified Oncology as the first field of medicine to explore gene therapy, followed by Cardiology (10.2%), Dentistry (9.3%), and Dermatology (7.4%).



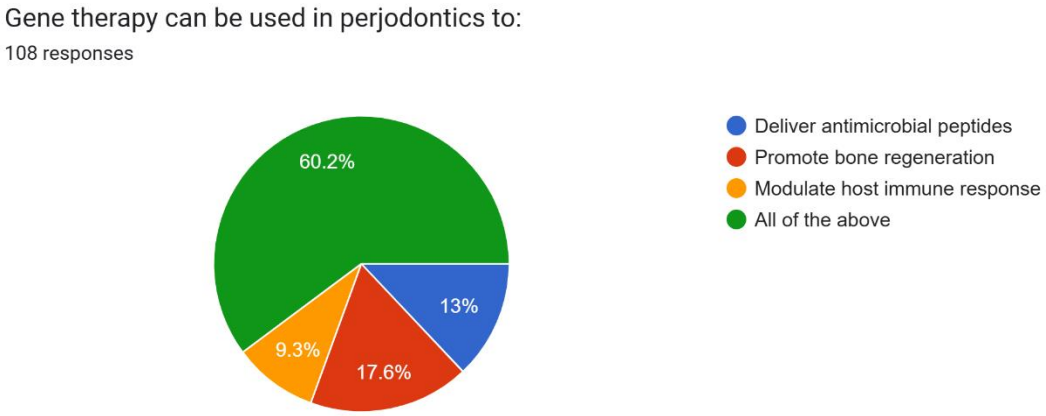
Among 108 respondents, the most commonly chosen vector for gene therapy was Viruses (32.4%), followed by Plasmids (31.5%), Bacteria (24.1%), and Enzymes (12%).



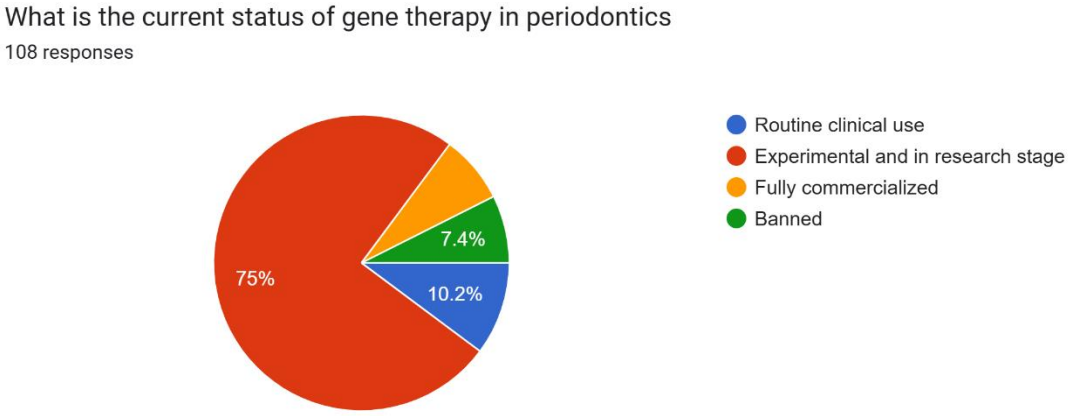
Out of 108 respondents, the majority (53.7%) correctly identified Liposome as a non-viral gene delivery method, while others selected Retrovirus (25.9%), Lentivirus (16.7%), and Adenovirus (3.7%).



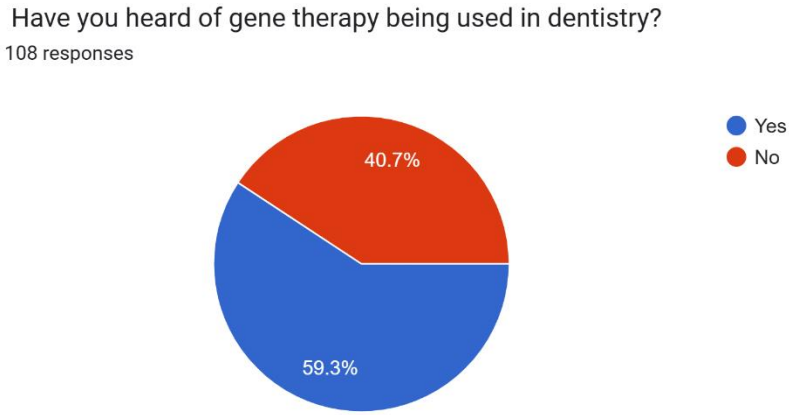
Out of **108 total responses**, the majority (**68.5%**, 74 respondents) identified **regeneration of periodontal tissues** as the major advantage of gene therapy in periodontics.



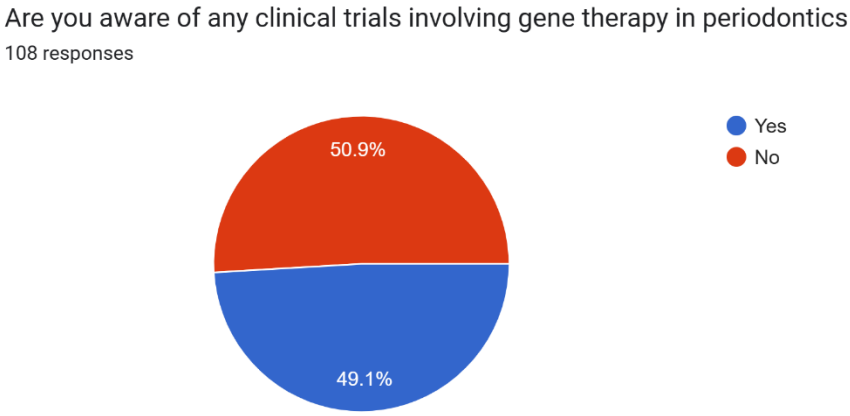
Out of **108 total responses**, the majority (**60.2%**, 65 respondents) stated that gene therapy can be used in periodontics for **all of the above** purposes.



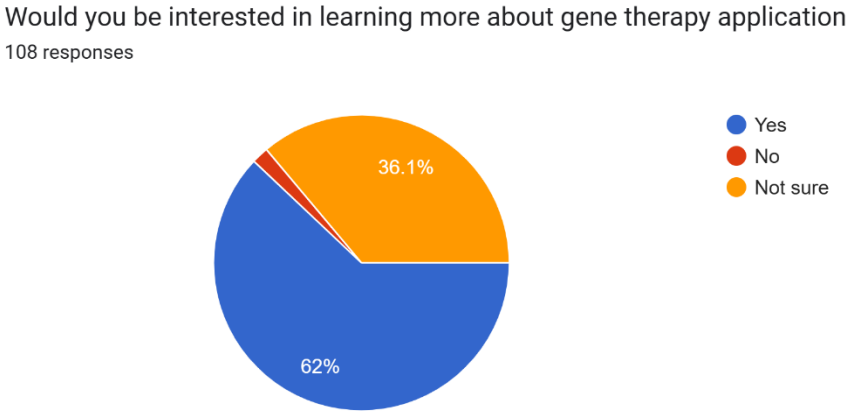
A total of **108 responses** were collected. The majority (**75%**) indicated that gene therapy in periodontics is still **experimental and in the research stage**. Only **10.2%** reported **routine clinical use**, **7.4%** said it is **banned**, and **7.4%** noted it is **fully commercialized**.



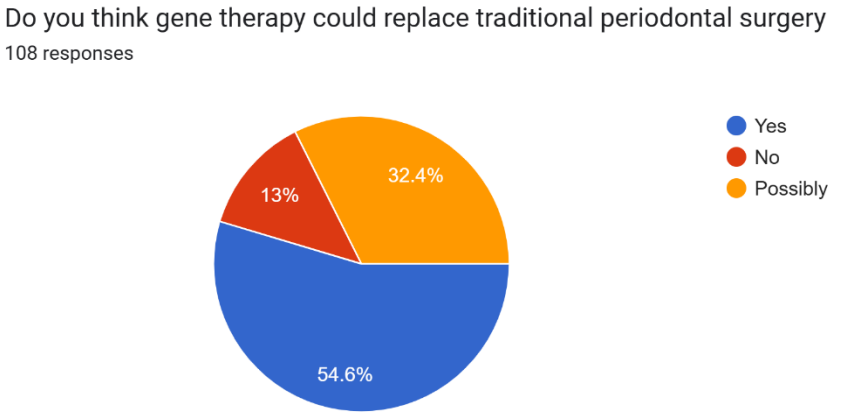
Out of **108 responses**, **59.3%** of participants have **heard of gene therapy being used in dentistry**, while **40.7%** have **not heard of it**.



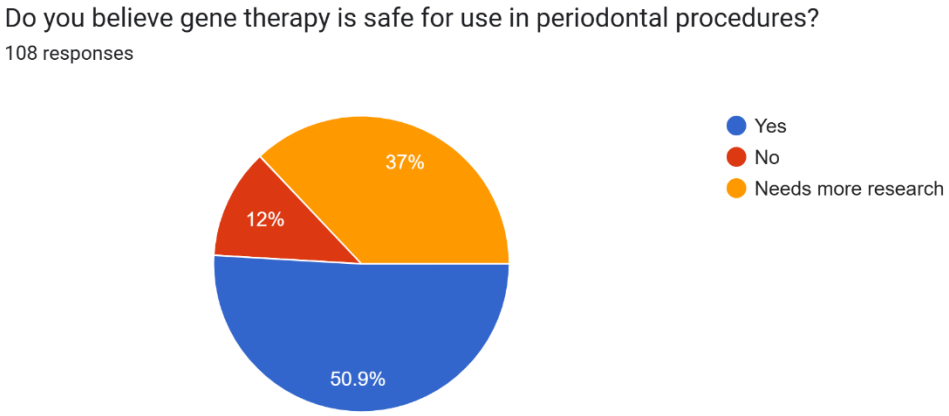
Out of **108 responses**, **49.1%** of participants are **aware** of clinical trials involving gene therapy in periodontics, while **50.9%** are **not aware** of any such trials.



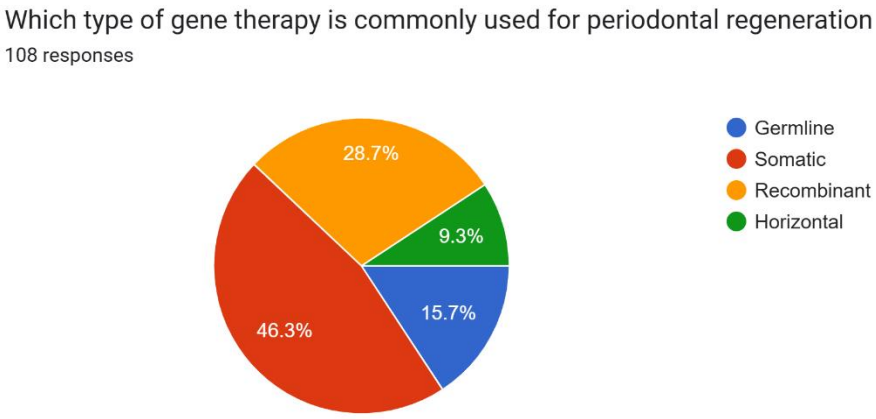
Out of 108 responses, **62%** showed interest in learning about gene therapy, **36.1%** were unsure, and only **1.9%** said no.



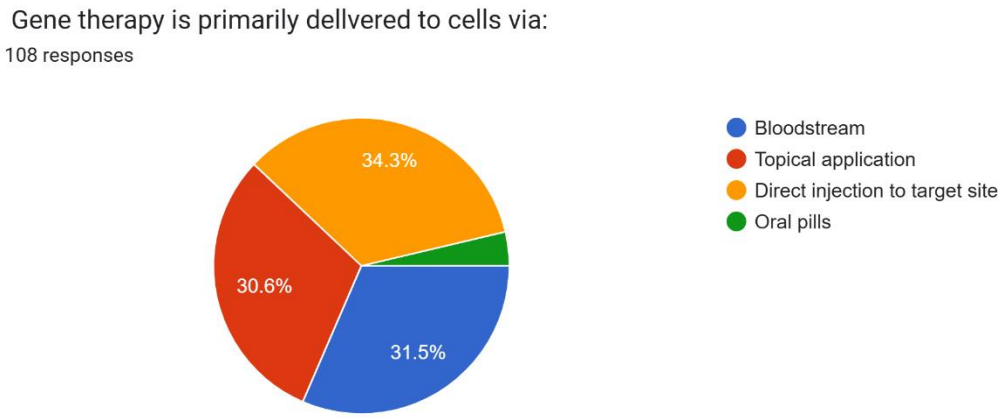
Out of 108 responses, **54.6%** believe gene therapy could replace traditional periodontal surgery, **32.4%** said *possibly*, and **13%** said *no*.



Out of 108 responses, **50.9%** believe gene therapy is safe for periodontal procedures, **37%** think it needs more research, and **12%** believe it is not safe.

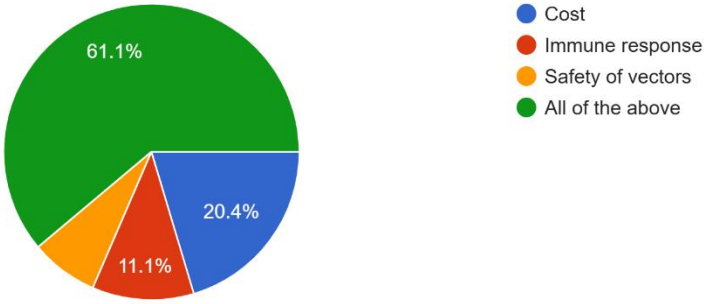


Out of 108 responses, **Somatic gene therapy** was most preferred (46.3%), followed by **Recombinant** (28.7%), **Germline** (15.7%), and **Horizontal** (9.3%)



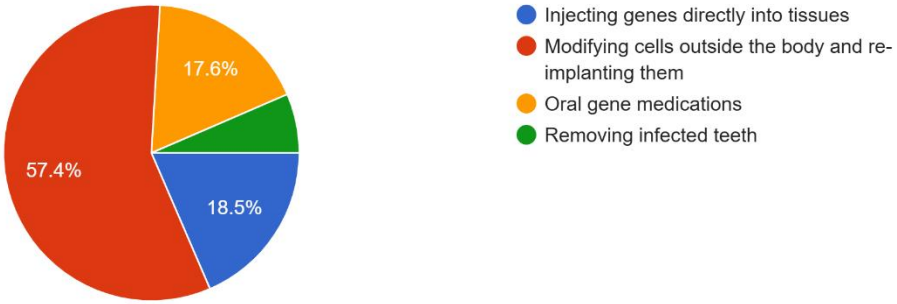
Out of 108 responses, **direct injection to the target site** was most chosen (34.3%), followed by **bloodstream** (31.5%), **topical application** (30.6%), and **oral pills** (3.6%).

A major challenge in gene therapy is:
108 responses



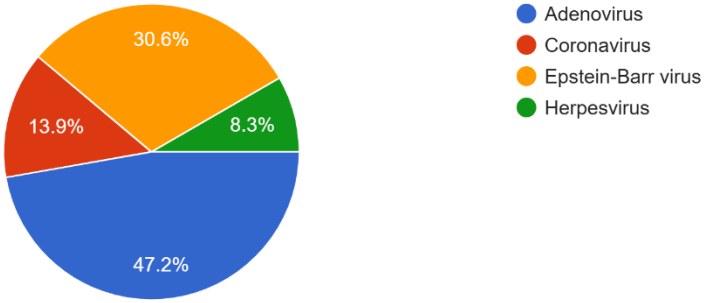
Out of **108 responses**, **61.1%** chose **"All of the above"** as major gene therapy challenges, while **cost (20.4%)**, **immune response (11.1%)**, and **safety of vectors (7.4%)** followed.

Ex vivo gene therapy involves:
108 responses

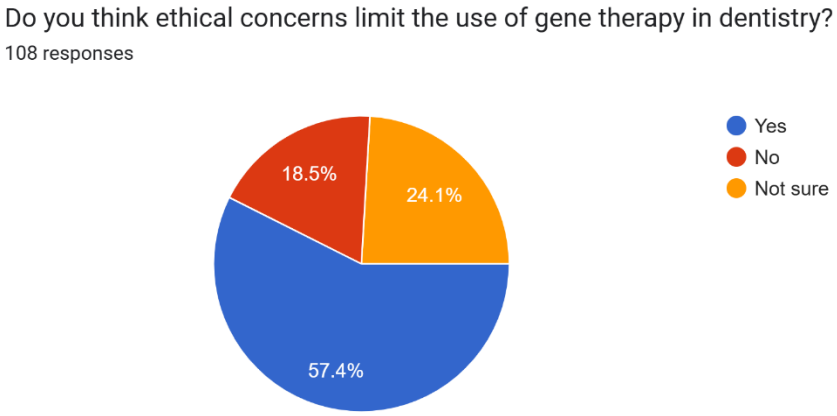


Out of **108 responses**, **57.4%** correctly identified that **ex vivo gene therapy involves modifying cells outside the body and re-implanting them**. Other responses included **injecting genes directly (18.5%)**, **oral gene medications (17.6%)**, and **removing infected teeth (6.5%)**.

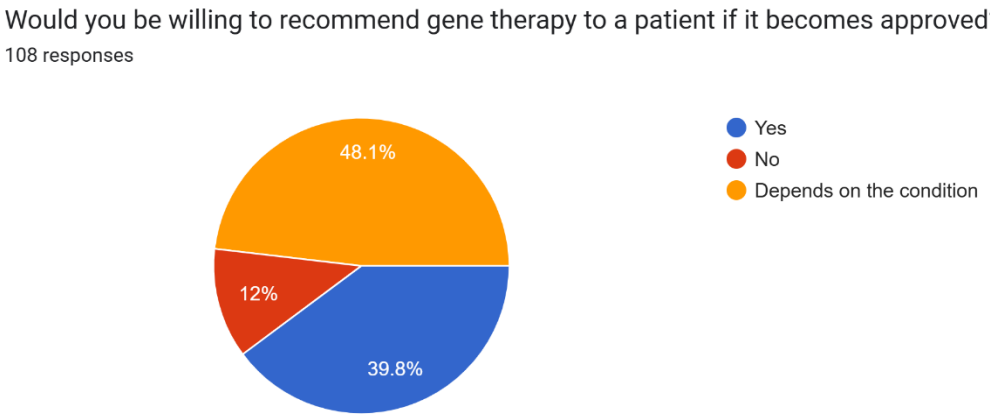
Which viral vector has shown promising results in gene therapy for periodontics?
108 responses



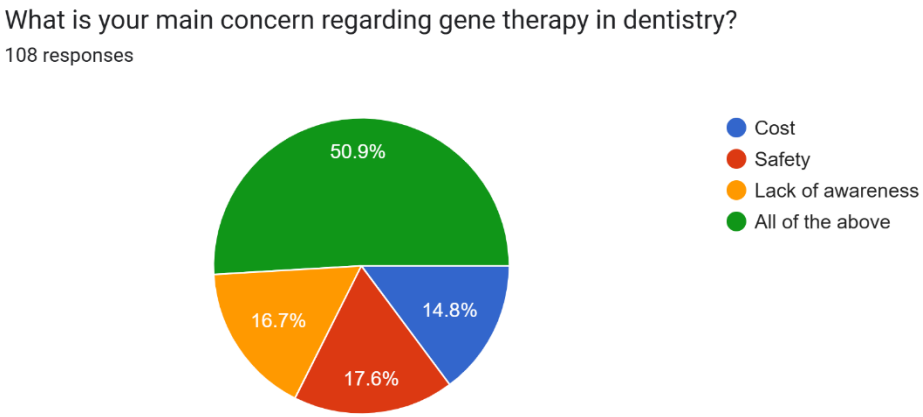
Out of **108 responses**, **47.2%** identified **Adenovirus** as the viral vector showing promising results in gene therapy for periodontics, followed by **Epstein-Barr virus (30.6%)**, **Coronavirus (13.9%)**, and **Herpesvirus (8.3%)**.



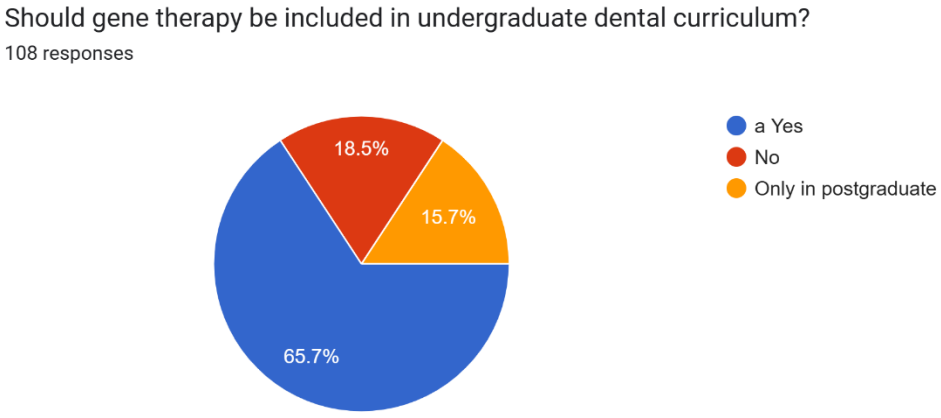
Out of **108 responses**, **57.4%** believe ethical concerns **limit the use of gene therapy in dentistry**, while **18.5%** disagree and **24.1%** are **not sure**.



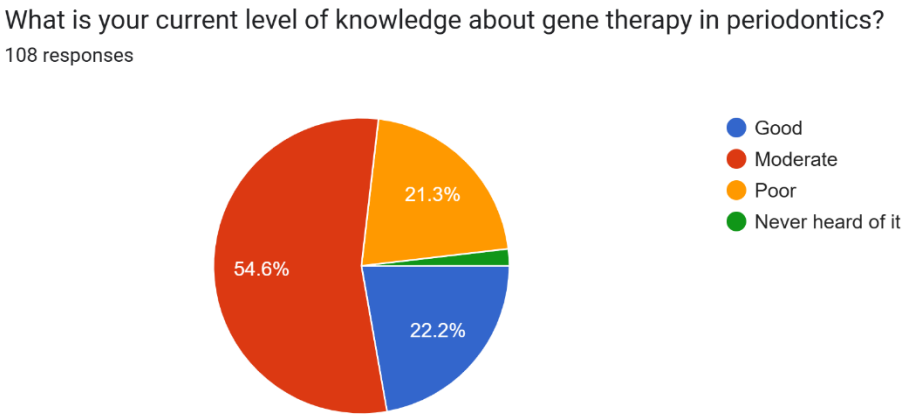
Out of **108 responses**, **39.8%** are **willing to recommend gene therapy** to patients if approved, **12%** said **no**, and **48.1%** stated it **depends on the condition**.



Out of **108 responses**, **50.9%** identified **all of the above** (cost, safety, and lack of awareness) as their main concern regarding gene therapy in dentistry, followed by **safety (17.6%)**, **lack of awareness (16.7%)**, and **cost (14.8%)**.



Out of **108 responses**, **65.7%** believe that **gene therapy should be included in the undergraduate dental curriculum**, **18.5%** say **No**, and **15.7%** think it should be taught **only in postgraduate studies**.



Out of **108 responses**, **54.6%** reported a **moderate** level of knowledge about gene therapy in periodontics, **22.2%** rated their knowledge as **good**, **21.3%** as **poor**, and **1.9%** had **never heard of it**.

Discussion

This survey evaluated the awareness and perceptions of gene therapy in periodontics among dental professionals and students. Most respondents were BDS students with limited clinical experience, similar to findings by Mahale et al.[1] and Chatterjee et al.[2], indicating that interest in gene therapy is growing among young dental professionals. A majority correctly defined gene therapy and identified oncology as its first field of application, consistent with earlier literature highlighting its origins in cancer research (Giannobile & Somerman[17]; Baum & O'Connell[6]). Viral vectors, particularly adenoviruses, were most recognized for gene delivery, as supported by Jin et al.[18], while over half correctly identified liposomes as a non-viral method, reflecting awareness of safer alternatives (Wang et al.[25]).

Participants widely acknowledged the regenerative potential of gene therapy, particularly in periodontal tissue regeneration, echoing the results of Chen et al.[20] and Kaigler et al.[22]. However, the majority perceived it as still experimental, aligning with reports by Goker et al.[4] and Barhate et al.[5] that emphasize its limited clinical translation. Although over half had heard of gene therapy in dentistry, only about half were aware of clinical trials, highlighting partial exposure to ongoing research (Gupta et al.[3]). Encouragingly, most participants showed strong interest in learning about gene therapy and supported its inclusion in the undergraduate curriculum, as recommended by previous reviews (Mahale et al.[1]; Barhate et al.[5]).

While many respondents believed gene therapy could eventually replace surgical procedures, safety, ethical concerns, and high cost remained major perceived barriers, consistent with findings from Naruishi and Nagata[23] and Mohan et al.[28]. Preference for somatic gene therapy reflected awareness of its ethical acceptability over germline modifications (Nishimura & Terranova[16]). Overall, the study indicates moderate knowledge but positive attitudes toward gene therapy in periodontics, highlighting the need for increased education, research exposure, and curricular integration to prepare future clinicians for regenerative approaches in periodontal care (Giannobile[29]; Shand et al.[27]; Sharma et al.[30]).

Conclusion

This survey revealed that most respondents were BDS students (87%) with limited clinical experience (73.6%) and a moderate level of knowledge (54.6%) about gene therapy in periodontics. While 71.3% correctly defined gene therapy and 73.1% recognized oncology as its first field, awareness of its dental applications was moderate, with 59.3% having heard of it and 49.1% aware of clinical trials. Viruses (32.4%) were the most recognized vectors, and 53.7% identified liposomes as non-viral carriers. Regeneration of periodontal tissues (68.5%) was viewed as the main advantage, and 60.2% believed gene therapy could serve multiple purposes. Although 75% considered it still experimental, most participants showed strong interest in learning (62%), believed it could replace surgery (54.6%), and supported its inclusion in the curriculum (65.7%). Ethical concerns, cost, and safety were cited as key challenges, highlighting the need for education, awareness, and further research before clinical integration.

References

1. Mahale S, Dani N, Ansari SS, Kale T. Gene therapy and its implications in periodontics. *J Indian Soc Periodontol.* 2009;13(1):1–5.
2. Chatterjee A, Singh N, Saluja M. Gene therapy in periodontics. *J Indian Soc Periodontol.* 2013;17(2):156–61.
3. Gupta P, Jan SM, Shafi M, Mir RA, Teli ZA. Gene therapy in periodontics: a review. *Int J Curr Res.* 2021;13(8):18045–50.
4. Goker F, Larsson L, Del Fabbro M, Asa'ad F. Gene delivery therapeutics in the treatment of periodontitis and peri-implantitis: a state-of-the-art review. *Int J Mol Sci.* 2019;20(14):3551.
5. Barhate A, Bajaj P, Shirbhate U, Reche A, Pahade A, Agrawal R. Implications of gene therapy in dentistry and periodontics: a narrative review. *Cureus.* 2023;15(11):e49437.
6. Baum BJ, O'Connell BC. The impact of gene therapy on dentistry. *J Am Dent Assoc.* 1995;126(2):179–89.
7. Baum BJ, Kok M, Tran SD, Yamano S. The impact of gene therapy on dentistry: revisiting after six years. *J Am Dent Assoc.* 2002;133(1):35–44.
8. Rathi E, Babu P, Vidyasagar S, Reddy SH. Gene therapy – future in regenerative periodontics. *Int J Dent Allied Sci.* 2015;7(1):10046.
9. Takiar M, Jaiswal R, Sachdeva S, Takiar S. Gene therapy: progress and prospects in dentistry. *Int J Curr Res.* 2010;4(1):86–90.
10. Durge GG. Future strategies of gene therapy for preventing periodontal diseases. *Int J Sci Res Sci Technol.* 2023;10(3):282–91.
11. Li H, Du W, Ye X, Luo X, Duan X. Genetic analysis of potential markers and therapeutic targets for immunity in periodontitis. *Front Dent Med.* 2024;5:1480346.

12. Zhang J, Chen L, Yu J, Li R, Wang M, Xu L, et al. Advances in mesenchymal stem cell-derived microRNAs on periodontal tissue regeneration. *Stem Cell Res Ther.* 2024;15(1):393.

13. Gupta S. The action of gene polymorphism in the pathogenesis of periodontal diseases: a narrative review. *Univ J Dent Sci.* 2022;8(4):20–4.

14. Kinane DF, Shiba H, Hart TC. The genetic basis of periodontitis. *Periodontol 2000.* 2005;39(1):91–117.

15. Raj S, Ravinder R, Mishra P. Gene therapy: a review. *Int J Res Rev.* 2021;8(6):35–9.

16. Nishimura F, Terranova VP. Clinical applications of gene therapy for periodontal regeneration. *Periodontol 2000.* 1998;19(1):75–87.

17. Giannobile WV, Somerman MJ. Growth and amelogenin gene therapy for periodontal tissue engineering. *J Periodontol.* 2003;74(3):321–9.

18. Jin Q, Anusaksathien O, Webb SA, Printz MA, Giannobile WV. Engineering of tooth-supporting structures by delivery of PDGF gene therapy vectors. *Mol Ther.* 2004;9(4):519–26.

19. Jin Q, Cirelli JA, Park CH, Sugai JV, Taba M Jr, Kostenuik PJ, et al. RANKL gene transfer to bone marrow stromal cells promotes alveolar bone regeneration. *Tissue Eng.* 2006;12(10):2743–53.

20. Chen J, Park CH, Gauthier P, Nor JE, Giannobile WV. Effects of a PDGF gene-activated matrix on periodontal wound healing. *Biomaterials.* 2006;27(31):5592–9.

21. Yamada Y, Ueda M, Hibi H, Baba S. A novel approach to periodontal tissue regeneration with mesenchymal stem cells and platelet-rich plasma. *Tissue Eng.* 2006;12(4):949–58.

22. Kaigler D, Avila-Ortiz G, Travan S, Taut AD, Padial-Molina M, Mimouni D, et al. Gene therapy and tissue engineering for periodontal regeneration. *J Dent Res.* 2015;94(9 Suppl):S143–52.

23. Naruishi K, Nagata T. Biological effects of gene therapy on periodontal regeneration. *J Oral Sci.* 2018;60(3):305–13.

24. Kato H, Taguchi Y, Tominaga K, Umeda M, Tanaka A, Komori T, et al. Adiponectin gene therapy for periodontal tissue regeneration. *J Periodontal Res.* 2020;55(3):407–15.

25. Wang L, Liu Y, Yu Q, Jin X, Zhang S. Viral and non-viral gene delivery systems for periodontal tissue engineering. *Front Bioeng Biotechnol.* 2021;9:682383.

26. Gopinath V, Shanmugam V, Anbazhagan R, Lakshmi T. Applications of gene therapy in periodontics – a review. *J Pharm Bioallied Sci.* 2020;12(Suppl 1):S10–S13.

27. Shand JM, Gibbs SR, Chaudhari A, et al. Gene-enhanced tissue engineering for periodontal regeneration: recent advances and future directions. *Dent Clin North Am.* 2022;66(2):271–85.

28. Mohan R, Pathak J, Biswas S. Regenerative approaches in periodontics: role of gene therapy. *J Oral Biol Craniofac Res.* 2019;9(3):201–6.

29. Giannobile WV. Periodontal tissue engineering by growth-factor gene transfer. *Adv Dent Res.* 2000;14:35–9.

30. Sharma S, Gupta R, Jain S. Gene therapy in dentistry: a review. *J Oral Health Comm Dent.* 2016;10(2):53–8.