

# Unveiling Dental Professionals' Perception of Dental Stem Cell Applications

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## ABSTRACT

**Aim:** To assess the awareness, knowledge, and attitudes of dental professionals regarding dental stem cells, identify challenges in their adoption, and explore strategies for integrating them into academic and clinical practices.

**Methodology:** A cross-sectional study surveyed 800 dental professionals in Western and Northern Maharashtra using a structured questionnaire distributed via professional networks and an educational PowerPoint presentation on dental stem cell was provided to enrich participants knowledge on the topic. Data were analyzed using SPSS version 22.0, employing descriptive statistics and paired sample tests.

**Results:** The study found that 87% of respondents were aware of stem cells, but only 43% were familiar with dental stem cell banking. Most respondents (62.7%) identified both primary and permanent teeth as sources of dental stem cells, while 62.4% recognized the suitability of non-pathologic teeth for banking. Barriers included lack of awareness (77.5%) and high costs (67.5%). Nearly 92% supported the inclusion of dental stem cells in academic curricula.

**Conclusion:** While awareness of dental stem cells is high, gaps in practical knowledge and accessibility remain. Educational initiatives, curriculum integration, and strategic awareness programs are crucial for empowering dental professionals and advancing stem cell-based regenerative dentistry.

**Keywords:-** Dental stem cells, Regenerative dentistry, Stem cell therapy, Stem cell preservation, Therapeutic potential.

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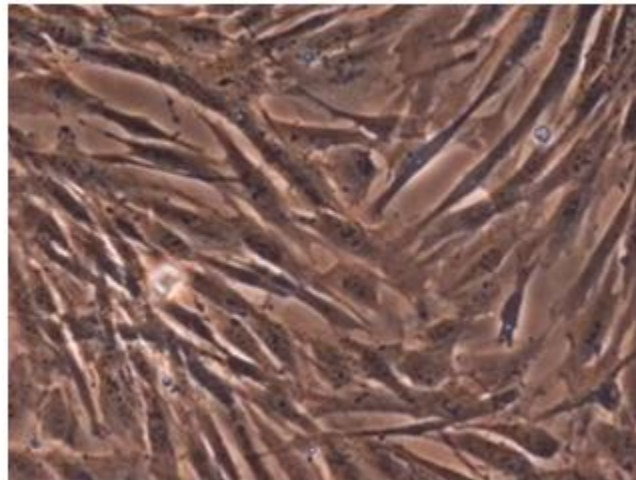
## INTRODUCTION

Stem cells can self-renew and become specialized cell types, offering potential in regenerative medicine for treating diseases and repairing tissues. They may help in conditions like heart disease, neurodegenerative disorders, and injuries, but challenges such as immune rejection, cancer risks, and proper integration need to be addressed for safe clinical use [1]. Embryonic stem cells in the mammalian blastocyst form all tissue lineages at gastrulation and are pluripotent. Adult tissues also have stem cells that regenerate site-specific tissues, like neural, muscle, and bone marrow cells, which can differentiate beyond their usual limits. Stem cell biology advances regenerative medicine, with embryonic and adult stem cells offering potential for tissue replacement via transplantation or stimulating in vivo regeneration [2]

Teeth are complex organs formed from tooth germ tissue, comprising enamel, dentin, cementum, pulp, and periodontal tissue, making regeneration challenging. Dental stem cells, found in the dental pulp and periodontal ligament, have the potential to differentiate into various cell types needed for tooth regeneration. Their ability to regenerate tissues may lead to innovative treatments for dental injuries and diseases, paving the way for advancements in regenerative dentistry [3].

There are five main types of dental stem cells that have been identified with potential applications in regenerative dental therapies: dental pulp stem cells (DPSCs), derived from the pulp tissue of teeth [4]; stem cells from exfoliated deciduous teeth (SHED), harvested from naturally shedding baby teeth [5]; periodontal ligament stem cells (PDLSCs), located in the connective tissue holding the tooth in place [6]; stem cells from apical papilla (SCAP), found at the tip of developing tooth roots [7]; and dental follicle progenitor cells (DFPCs), derived from the tissue surrounding developing teeth [8]. Recent advances in tissue engineering and regenerative medicine have revealed that these cells, including

DPSCs, SHED, PDLSCs, SCAPs, and DFCs, hold significant promise for regenerating dental and other types of tissues, making them key players in future therapeutic innovations [9]



**Fig. 1: Spindle shaped dental stem cells in culture media. Phase contrast microscopy original magnification: X100 [10]**

Awareness of dental stem cells remains limited among dental professionals. The study by Goswami et al. found that while 72% of dental professionals were aware of dental stem cells, much of their knowledge came primarily from dental curriculum books. Though 81% of respondents knew about different types of stem cells, only 28% understood the procedure for procuring them, indicating gaps in practical knowledge. Furthermore, just 33.3% were aware of dental stem cell banks in India. Despite these limitations, the study concluded that awareness and knowledge of dental stem cells are influenced by age and practice type, and there is a generally positive attitude toward recommending dental stem cell banking [11].

The aim of the study is to evaluate the awareness, knowledge, and attitudes of dental professionals towards dental stem cells, while identifying challenges in their adoption and exploring strategies for integrating dental stem cell education into academic and clinical practice. The objectives of the study were to assess the awareness, knowledge, and attitudes of dental professionals regarding the sources, preservation, and clinical applications of dental stem cells. Additionally, the study identify the perceived barriers and challenges that dental professionals face in adopting dental stem cell therapies in clinical practice. Furthermore, it sought to gather insights and recommendations for integrating dental stem cells into academic curricula, continuing education, and future awareness programs, with the goal of enhancing understanding and facilitating the adoption of stem cell-based therapies in dentistry.

## METHODOLOGY

### Study Design and Participants

This cross-sectional study aimed to assess the awareness, attitude, and knowledge of dental stem cells among dental professionals. Participants, including BDS, MDS, and PhD holders, were recruited through professional networks, emails, and social media platforms. After explaining the purpose of the study dental professionals who consented to participate in the study and give their valuable feedback were included in this study. UG students and non practicing dental professionals were excluded.

### Sample Size Determination

The required sample size for this study was calculated using G\*Power version 3.1.9.4 software applying a  $\chi^2$  goodness-of-fit test with an effect size ( $w$ ) of 0.17, alpha error probability of 0.05, power of 0.80, and degrees of freedom (Df) of 20. This calculation indicated a sample size of 726 to achieve 80% power, with a critical  $\chi^2$  value of 31.41 and a noncentrality parameter ( $\lambda$ ) of 20.98. To account for potential non-responses or incomplete data, the sample size was increased to 799 participants, rounded off to 800.

### Questionnaire Development and Reliability

A structured close ended pre and post questionnaire and an educational power point presentation on dental stem cells was designed. The Pre questionnaire contains 15 questions divided into 3 sections; demographic information, awareness and attitude about dental stem cells. A pilot study of 25 participants was conducted and reliability and validity of questionnaire was calculated through Cronbach's alpha, indicating moderate internal consistency. Education material on dental stem cells in the form of a power point presentation was prepared and shared with those who

answered pre- questionnaire. The post knowledge based questionnaire contains 10 questions which were sent and responses were collected online.

**Data Collection**

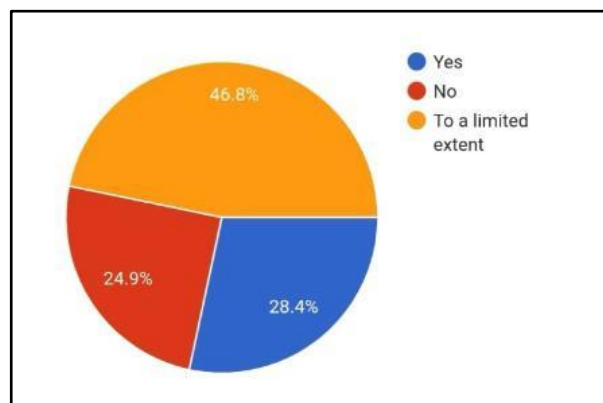
The survey was administered via Google Forms through professional networks, emails and social media platforms .Participants were informed of the purpose of the study and assured confidentiality and voluntary participation. It was distributed among the Western and Northern Maharashtrian dental professionals .

**Data Analysis**

Data from the survey responses were recorded and organized in Microsoft Excel, followed by statistical analysis in SPSS version 22.0. Descriptive statistics summarized the demographic data, and paired sample tests assessed knowledge improvements post-educational intervention. A significance level of 0.05 was maintained throughout, and results were presented in tables and graphs for clear interpretation.

**RESULT**

The survey, conducted among 800 dental professionals aged 20 to 58, provided a wellrounded perspective across various career stages. Gender representation was nearly equal, with 52.4% female and 47.8% male participants. Educational backgrounds included 42.8% with BDS, 46% with MDS, and 9.7% with a PhD. Over 80% of respondents were early career professionals (less than five years of experience), 15% were mid-career (five to ten years), and 5% were seasoned professionals (over ten years). A significant 87% of respondents were aware of stem cells, indicating a strong openness to advanced knowledge in the field.



**Figure 2:-Awareness of Dental Stem Cells among Respondents**

Figure 2 illustrates respondents' awareness of dental stem cells. The data reveals that 46.8% of participants possess limited knowledge, 28.4% are aware, and 24.9% are entirely unaware.

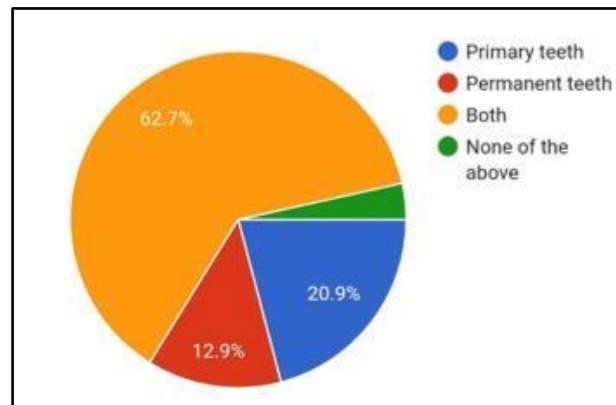
Survey results show that 60% of respondents are fully aware of regenerative dentistry with dental stem cells, while 25% have limited understanding and 15% are unaware. Regarding the potential for dental stem cells to develop non-dental tissues, 55% are confident, 20% are cautiously optimistic, and 7% are skeptical. Awareness of dental stem cell banking in India is at 43%, but 88% are interested in learning more, with 71% highly interested.

Table 1		
Ways to increase awareness of dental stem cells and their preservation	Total number of responses (Numbers)	Total number of responses (Percentage %)
1) Seminars	106	13.2 %
2) Journals	31	3.9 %
3) Conference and CDE programs	68	8.5 %
4) Inclusion in academic curriculum	161	20.1 %
5) Advertisements	137	
6) All of these	297	
<b>TOTAL</b>	<b>800</b>	<b>100 %</b>

Table 1 shows that 37.1% of respondents favor a combination of methods to raise awareness about dental stem cells, with 20.1% prioritizing curriculum integration, 17.2% supporting advertisements, and 13.2% advocating for seminars. Conferences and journals were less favored at 8.5% and 3.9%, respectively.

Survey results highlight the primary challenges patients face in accessing dental stem cell therapy, with 77.5% identifying a lack of awareness as the main obstacle. High cost is also a significant barrier, cited by 67.5% of respondents, while ethical issues are less of a concern, mentioned by only 20%. Regarding the preservation of dental stem cells, 92.5% of respondents would recommend it, emphasizing the importance of awareness and affordability in patient decision-making.

Additionally, 91.75% of respondents believe that dental stem cell topics should be included in the undergraduate dental curriculum, while 6.13% are uncertain, and 2.13% disagree.



**Figure 3 :- Knowledge regarding origin of dental stem cell**

An educational presentation was shared to raise awareness and spread knowledge about dental stem cells and results received are as follows ,figure 3 illustrates the sources from which dental stem cells are derived, according to respondents' knowledge. The majority, 62.7% (502 respondents), believe that dental stem cells can be obtained from both primary and permanent teeth. Meanwhile, 20.9% (167 respondents) think they are derived only from primary teeth, and 12.9% (103 respondents) believe they come only from permanent teeth. A small percentage, 3.5% (28 respondents), selected "None of the above".

A majority, 62.4%, believe that teeth extracted due to non-pathologic conditions are suitable for stem cell banking, while 10.7% consider teeth extracted due to pathologic conditions viable. Additionally, 63.7% of respondents are aware of the dental stem cell banking procedure, with 12.7% lacking knowledge.

Regarding the applications of dental stem cells, 62.2% recognized multiple uses such as whole tooth regeneration and regeneration of periodontal ligament, cementum, alveolar bone, and pulp/dentin, while only 1.5% selected "None."

In terms of ethical concerns, 72% expressed awareness, while 28% did not perceive them as an issue. When it comes to dental stem cell types, 82.7% acknowledged a broad range of options, while only 1.1% selected stem cells from shedded human milk teeth. The majority (85%) identified Transcell Biologics Pvt. Ltd as a leading stem cell bank, while 60% recognized Reelabs.

For non-dental applications, 70% acknowledged therapeutic uses, with 5% selecting "None of the above." Concerning sources of information, 48% cited journals as their primary resource, while 9% referred to other sources. On preservation, 60% believed dental stem cells could be stored for a lifetime, while 2% selected "None of the above." Thus educational presentation shown to enrich the participants knowledge was found to be beneficial.

## DISCUSSION

Our survey data reveals that a significant number of respondents were aware of stem cells, indicating a strong openness to advanced knowledge in the field. A survey conducted by Hafsa Qubool et al. underscored a concerning lack of awareness among dental professionals regarding dental stem cells, mirroring the findings of our study. Contrastingly, research by Mridula Goswami et al. indicated a commendable level of awareness among respondents. Nonetheless, the overarching consensus across most studies emphasizes the pressing necessity for structured educational programs to elevate the knowledge and attitudes of dental professionals toward stem cell applications. This necessity is further reinforced by a study conducted by Nagappan Nagappan et al. , which advocates for comprehensive initiatives to address this critical gap in professional understanding [12 ,13,14]

When respondents were queried about the potential of dental stem cells in developing non-dental tissues, 55% expressed optimism, 20% conveyed uncertainty, 18% perceived limited potential, and 7% exhibited skepticism. These findings resonate with the observations of Israa Ahmed Radwan et al., who extensively reviewed protocols for inducing osteogenic and odontogenic regeneration through iPSC-derived progenitors, demonstrating the profound implications of dental stem cells in both dental and non-dental tissue engineering [15].

In the Indian context, only 43% of respondents were aware of dental stem cell (DSC) banking, though 88% showed a strong interest in exploring this domain, highlighting the urgent need for educational initiatives to bridge this gap. Similarly, a study by Rasha K. Alomar et al. in Saudi Arabia revealed limited public awareness of DSC benefits, yet strong support for a national DSC bank and moderate awareness among dental professionals [16]. Our survey also identified preferred strategies to enhance DSC awareness, with 37.1% favoring a multifaceted approach (“All of the above”), followed by dental curricula integration (20.1%), advertisements (17.2%), seminars (13.2%), conferences and CDE programs (8.5%), and journals (3.9%), aligning with recommendations by Goomer et al., Alhadlaq et al., Almaeen et al., and Chitroda et al. [17,18,19,20]. Notably, our study took an innovative step by sharing an educational presentation with participants to enhance their understanding of dental stem cells and disseminate knowledge. This pioneering approach of directly engaging respondents with well-curated educational material marks a significant departure from conventional methodologies, establishing a unique precedent in the exploration of this field.

The survey also shed light on barriers to accessing dental stem cell therapy, with 77.5% of respondents identifying a lack of awareness as a significant hurdle, followed by high costs (67.5%) and ethical concerns (20%). These findings echo the insights of George T-J Huang et al. , who have similarly highlighted these challenges in the context of stem cell applications in dentistry [21].

Furthermore, the survey revealed that 62.7% of respondents believed dental stem cells could be derived from both primary and permanent teeth, while 20.9% attributed their origin to primary teeth exclusively, 12.9% to permanent teeth, and 3.5% expressed uncertainty. These findings are corroborated by Xin Shi et al., who provided empirical evidence supporting the derivation of stem cells from a broad range of dental tissues [22].

In exploring the suitability of teeth for stem cell banking, 62.4% of respondents considered teeth extracted due to non-pathologic conditions as ideal, while 14.7% identified carious teeth, 12.2% selected exfoliated teeth, and 10.7% preferred teeth extracted for pathologic reasons. Research by Werle et al. affirmed the equivalence of tissue differentiation potential in stem cells derived from carious and healthy deciduous teeth [23], while Tsai et al. offered comparative insights into stem cell recovery efficiency based on the severity of dental caries [24].

The survey also highlighted varying degrees of knowledge about dental stem cell banking post-tooth extraction, with 63.7% of respondents demonstrating familiarity, 23.6% expressing uncertainty, and 12.7% acknowledging a lack of knowledge. These findings, supported by P. M. Sunil et al. , emphasize the critical need for targeted educational initiatives to inform practitioners about the preparatory steps involved in banking dental stem cells [25].

Significantly, 62.2% of respondents recognized the extensive applications of dental stem cells in tissue regeneration, including dentin, pulp, periodontal tissues, and whole tooth replacement. Specific focus areas included whole tooth regeneration (17.4%), periodontal structure regeneration (11.4%), pulp/dentin regeneration (7.5%), with only 1.5% dismissing their applications altogether. These insights are supported by R. Bansal et al. , who highlighted the regenerative potential of gingival mesenchymal stem cells (GMSCs) in bone regeneration and their anti-inflammatory properties [26].

Consistent with these findings, our survey revealed that 72% of respondents acknowledged ethical concerns surrounding the use of dental stem cells, reflecting the diverse perspectives that characterize this evolving field. Lastly, clinical investigations by Vladislav Volarevic et al. have underscored the profound therapeutic promise of stem cell-based therapies for degenerative, autoimmune, and genetic disorders, while also addressing ethical and safety concerns that continue to provoke debate [27].

## CONCLUSION

In conclusion, this study highlights both the promise and the challenges of integrating dental stem cell applications into clinical practice. While there is a significant level of awareness and a positive attitude among dental professionals toward their potential in regenerative dentistry, critical gaps persist in practical knowledge, accessibility, and ethical understanding. Addressing these gaps through comprehensive educational initiatives, curriculum integration, and strategic awareness programs is essential to empower dental professionals to harness the transformative capabilities of dental stem cells. By overcoming barriers such as high costs and limited awareness, the dental community can pave the way for innovative therapies that revolutionize patient care and advance the frontiers of regenerative medicine.

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