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Original Research Article

Assessing knowledge attitude and barriers to stem cell therapy among dental students of Dhule city: A cross-sectional study

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Abstract

Introduction: Stem cell therapy represents a groundbreaking approach with the potential to address various human bodily deficiencies. In contemporary practice, stem cells can be harvested from extracted teeth. This innovative application of dental tissue can yield significant advancements in regenerative medicine.
Aim & Objectives: To assess knowledge, attitude and barriers to stem cell therapy among dental students of Dhule city.
Objectives: To assess and evaluate the knowledge of dental students regarding stem cell therapy, to assess the attitude of dental students towards stem cell therapy and barriers associated with stem cell therapy in a dental setting.
Materials and Methods: A cross-sectional questionnaire study involved 400 undergraduate and postgraduate students at JMF's ACPM Dental College and Hospital in Dhule between November 2023 and January 2024. The questionnaire, consisting of 20 items that included both open-ended and closed-ended questions, was administered through electronic forms. The data collected were subsequently subjected to statistical analysis.
Result: The findings indicate that the knowledge of undergraduate and postgraduate students regarding stem cell therapy is comparable. However, doctoral students exhibit a more optimistic attitude towards stem cell therapy than their undergraduate counterparts. Participants identified several barriers, including affordability, lack of public awareness, ethical considerations, and concerns regarding safety and efficacy.
Conclusion: Dental stem cell therapy shows the potential to revolutionise dentistry by regenerating tissues and treating oral issues. While promising, research faces challenges like standardising protocols and ensuring long-term efficacy, alongside ethical considerations.

Keywords: Attitude, Barriers, Knowledge, Stem cells

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1. Introduction

Stem cells are a group of cells that can continuously produce unaltered daughter cells with varying but more specialized properties.[1] More specifically, stem cells can be defined as clonogenic, unspecialised cells that are capable of both self-replication and multi-lineage differentiation.[2]These cells can transform into various types, such as blood cells and muscle cells, and their potential extends beyond these functions; they can also differentiate into oral mucosa or even form an entire tooth. Given that stem cells are totipotent to a certain extent, they have numerous applications, ranging from prosthetic rehabilitation of defects to regenerative medicine and the management of congenital disorders.

In 1961, Drs. James Till and Ernest McCulloch discovered stem cells, which led to the development of regenerative medicine. Later, in 2000, a researcher from the National Institutes of Health highlighted the role of dentists in regenerative therapy by identifying stem cells in dental pulp. Stem cells can be classified into two categories: embryonic stem cells and adult (post-natal) stem cells. Adult stem cells are further divided into two subcategories: hematopoietic

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stem cells (HSCs) and non-hematopoietic mesenchymal stem cells (MSCs).[3] The application of stem cells in dental procedures has demonstrated the ability to regenerate damaged or missing tissues in the oral and maxillofacial regions, including teeth, bone, and gums. Consequently, this advancement has created new opportunities for addressing various diseases and injuries related to the oral and maxillofacial areas.

The advent of regenerative modalities in dentistry, which is still in its niche stages, includes stem cells, commonly referred to as dental stem cells (DSCs). These cells are a type of mesenchymal stem cell and can be easily isolated from various intraoral sites. Notable sources include Dental Pulp Stem Cells (DPSC), Stem Cells from Human Exfoliated Deciduous Teeth (SHED), Bone Marrow-Derived Mesenchymal Stem Cells from Orofacial Bone (BMSC), Periodontal Ligament Stem Cells (PDLSC), Dental Follicle Stem Cells (DFSC), Tooth Germ Progenitor Cells (TGPC), Stem Cells from Apical Papilla (SCAP), Oral Epithelial Stem Cells (OESCS), Gingiva-Derived Mesenchymal Stem Cells, Periosteum-Derived Stem Cells (PSC), and Salivary Gland-Derived Stem Cells (SGSC).[3] A recent review of the literature on the awareness of dental stem cell therapy revealed that 66% of dental participants were unaware of the ethical considerations and guidelines related to dental stem cells (DSCs) established by the Indian Council of Medical Research.[4] Therefore, for stem cell therapy to be successfully implemented in dentistry, dentists need to gain insight into stem cells and adopt a proactive approach to utilizing them in areas such as tissue engineering, developing therapies to restore dental tissue integrity, and reconstructing pulp tissue. Consequently, undergraduate, graduate, and postgraduate students, must deepen their understanding of this subject for future practice and integrate it into their curricula.

To address this gap, we conducted a study examining the knowledge, attitudes, and Barriers regarding stem cell therapy among undergraduate and postgraduate dental students. The objective of this research is to cultivate a sense of curiosity in future dentists. As technology continues to evolve, it is anticipated that this curiosity will inspire future dental professionals to strive for the development of cost-effective stem cell therapies, thereby enhancing accessibility and fostering an environment in which stem cell therapy becomes a standard procedure.

2. Materials and Methods

The study employed a cross-sectional questionnaire design and was conducted in Dhule City at JMF's ACPM Dental College and Hospital from November 2023 to January 2024. The Sampling Method was simple Random Sampling. The sample size was 400. The estimated sample size was 387, derived from the standard sample size formula utilized in previous studies. For standardization, the final sample size was adjusted to 400.

2.1 Inclusion criteria

The dental undergraduate students are in their third and fourth years at ACPM Dental College and Hospital.

The dental post-graduate students from all academic years at ACPM Dental College and Hospital.

2.2 Exclusion criteria

Undergraduate students in their first and second years of study.
Participants who did not provide their consent.
Permissions Acquired
Before commencing the study,
Permission was secured from the Institutional Review Board.
Permission was secured from the Principal of ACPM Dental College and Hospital.
Ethical approval for the conduct of the study was obtained from the Institutional Review Board (ECC/NEW/INST/2022/2259/2022/051). The study adhered to the STROBE guidelines.

Questionnaire: The total number of questions is 20. The data sources for this study include a range of published articles, as well as a questionnaire that encompasses all relevant aspects of the research. The study design comprises three sections. Section 1 focuses on demographic data. Section 2 is further divided into two parts: the first part evaluates knowledge and awareness through seven questions, while the second part assesses participants' practices with ten questions, utilizing a 4-point Likert scale with the following response options: Strongly Disagree, Disagree, Agree, and Strongly Agree. Section 3 includes three open-ended questions that address topics distinct from those covered in the preceding sections.

2.3 Data collection

The questionnaire was disseminated to participants through electronic forms, which included an informed consent document and a participant information sheet (PIS). Sufficient time was allocated for participants to review and respond to the questionnaire. The data collected was compiled through descriptive analysis and subsequently analyzed using the SPSS version 20 software.

2.4 Implications

This study aims to provide a comprehensive understanding of dental students' knowledge, attitudes, and awareness regarding stem cell therapy. The findings will be instrumental in identifying the discrepancies between the knowledge and awareness of dental students concerning stem cell therapy, thereby facilitating efforts to address these gaps. Additionally, if deemed necessary, educational seminars and/or workshops can be organized for future healthcare professionals to enhance their understanding of advancements in stem cell therapy.

3. Results

The study primarily included dental students (n=200) and Recently graduated (n=100), specifically interns, all of whom were under the age of 25. Conversely, the postgraduate students (n = 87) were above the age of 25 and also participated in the study.

Based on the responses and descriptive analysis, there is no statistically significant difference in knowledge and awareness of stem cells between undergraduate and postgraduate students. However, a more nuanced examination indicates a significant disparity in knowledge specifically related to Stem cells

Dental stem cells. Participants exhibit a robust awareness of Stem cells Dental stem cells, including their sources and potential applications; nevertheless, they demonstrate a limited understanding of the broader concept of stem cells (**Figure 1**).

The results of the study reveal that participants possess a significantly positive attitude towards acquiring knowledge about stem cell therapy in dentistry, with 85% expressing enthusiasm for the subject. Furthermore, participants exhibit a substantial level of optimism concerning the prospects of stem cell therapy. It is noteworthy that postgraduate students display a more optimistic perspective in comparison to interns. Additionally, participants aged over 25 years demonstrate a more favourable attitude than their counterparts aged under 25 years. (**Figure 2**).

This parity in attitudes highlights the importance of increasing awareness and altering the perspectives of future dentists concerning stem cell therapy at an earlier stage in the dental curriculum while considering factors such as age and educational background (**Figure 2** and **Figure 3**).

The participants identified several barriers to the implementation of stem cell therapy in dentistry, particularly the high costs associated with these treatments and a general lack of public awareness. Furthermore, some participants expressed concerns regarding the insufficient availability of centres or tooth banks. There is also a notable deficiency in awareness and understanding of the guidelines governing the practice of stem cell therapy, including its ethical implications, particularly concerning the use of embryos. Additionally, concerns regarding the safety and efficacy of such therapies, along with the slow approval process by the FDA, were significant issues raised by undergraduates and interns. These concerns appear to stem from a lack of awareness and knowledge regarding the guidelines for practising stem cell therapy (**Figure 4**).

An overall comparison of knowledge, awareness, and practices among the participants, categorized by their qualifications, reveals that the levels of knowledge and awareness regarding stem cell therapy are significantly higher than the knowledge related to its practical applications (**Figure 5**).

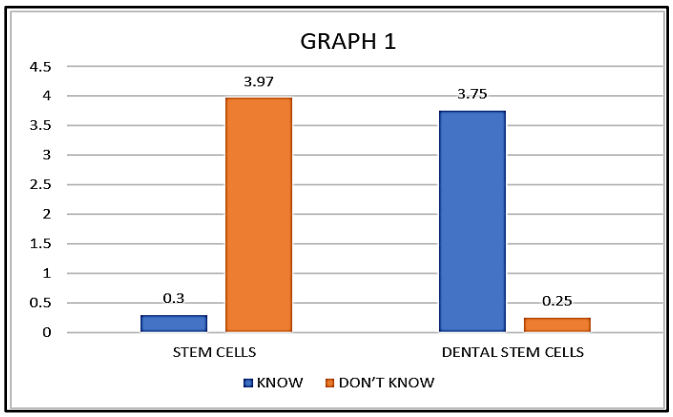

Figure 1: Comparison of knowledge of participants regarding stem cell and dental stem cell

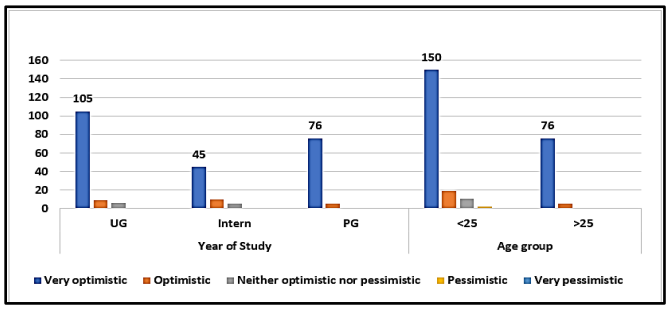

Figure 2: Comparision of attitude between ug, pg and interns based on age

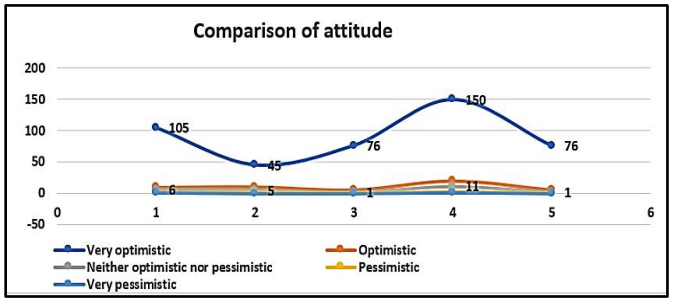

Figure 3: Comparison of attitude

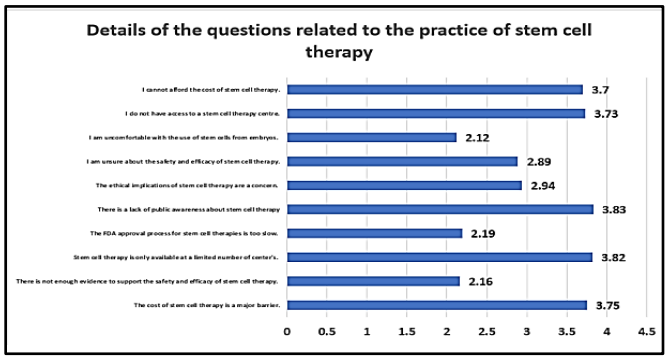

Figure 4: Barriers

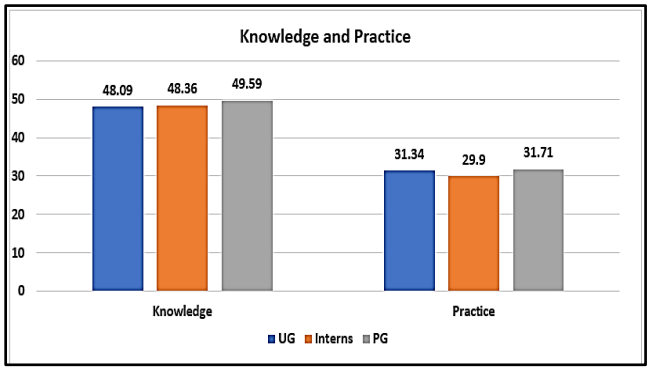

Figure 5: Comparison of known knowledge and practice done among ug, pg, interns.

4. Discussion

Two zoologists Theodor Heinrich Boveri (1862-1915) and Valentin Häcker (1864-1927) refer to cells that are committed to developing into the germline.[5] This concept is analogous to the necessity of fostering a sense of curiosity and interest in stem cell therapy among dental students. The majority of postgraduate students possess a comprehensive understanding of stem cells and their dental counterparts, with a reported proficiency rate of 100%. In contrast, only 25% of undergraduate students demonstrate awareness of stem cells, although 72% are familiar with dental stem cells. This disparity suggests that the overall knowledge and awareness of stem cells among undergraduate students is inadequate. It can be inferred that knowledge and awareness of stem cell therapy tend to improve with age and higher education. Therefore, there is a pressing need to address the knowledge gap among dental students in North Maharashtra by incorporating the study of stem cells and their untapped potential into the undergraduate curriculum.

This finding contrasts with a study conducted in Chennai by Nikita Sivakumar et al., which reported a minimal percentage difference in knowledge regarding stem cells in general (93%) compared to dental stem cells (83%). Furthermore, the majority of dental students in Chennai are aware of both stem cells and dental stem cells.

The emergence of regenerative dentistry has introduced various treatment modalities, one of which is stem cell therapy. Stem cells possess the unique ability to differentiate into any type of cell, demonstrating totipotency. This characteristic, along with their capacity for differentiation, underscores the significant potential of stem cell therapy in dentistry and its numerous applications.

Among the various types of oral cavity-derived stem cells, dental pulp stem cells (DPSCs) are regarded as the most accessible form of stem cells, offering a straightforward and minimally invasive method for their procurement and preservation.[6] This approach serves as a simpler alternative to the extraction of stem cells from other tissues. Furthermore, utilizing autologous stem cells for potential future injuries or diseases mitigates the risks associated with graft-versus-host disease, as it reduces the likelihood of graft-versus-host disease as there are chances of possible immune rejection.[7] (**Figure 5**)

There are numerous applications for progenitor cells, including continued root formation, regeneration of immature teeth with extensive pulp damage, periodontal regeneration, the development of biological teeth, and stem cell-based therapies.[8] Therefore, it can be concluded that dental stem cells offer significant benefits, which underscores the necessity and rationale for the storage of these cells.[9]

The application of dental stem cells represents a relatively novel treatment modality within the field of dentistry. However, there exists a significant gap in knowledge regarding various aspects of dental stem cells, including their uses, sources, isolation, storage, and applications. Additionally, ethical concerns, accessibility issues, and cost-effectiveness further complicate the situation, compounded by a general lack of awareness among both practitioners and the public. This assertion is substantiated by a study in which nearly all participants reported being uninformed about the procedures involved in stem cell therapy and expressed various misconceptions that hinder its implementation. For instance, 83.5% of participants indicated discomfort with the use of embryos. This finding aligns with research conducted by Paola Farti et al.[10] which revealed that 70% of participants held a negative attitude towards human embryo research. These misconceptions suggest a broader issue of insufficient awareness and knowledge in the field, as evidenced by participants' unfamiliarity with the current state of research and advancements in dental stem cell therapy.

The term was first introduced by Wilson. In 1908, Alexander Maksimov, a histologist from Russia, proposed the existence of hematopoietic stem cells.[11] The discovery of postnatal stem cell populations in dental pulp by Gronthos and Shi[12] in 2000 significantly advanced stem cell research and further integrated the dental profession into the burgeoning field of regenerative medicine.[13] However, it was not until 2004 that the first commercial tooth bank was established as a venture at Hiroshima University in Japan.[14]

An analysis of tooth banks in India indicates that they are primarily situated in major metropolitan regions, such as Stemade Biotech Pvt and Ree Labs in Mumbai, Mother Cell in Hyderabad, and Small Bites in Bengaluru.[15] Participants have identified the limited number of centres as a substantial obstacle to the provision of stem cell therapy. Furthermore, the high cost of therapy, coupled with restricted access due to the scarcity of centres, further hinders the availability of these services.

A considerable proportion of participants reported encountering various barriers that impede their investigation into the affordability of dental stem cell therapy. These barriers include a lack of public awareness (87.6%), ethical

considerations (88.3%), and apprehensions regarding safety and efficacy (81.6%). These findings align with a study conducted by Katge et al. in Maharashtra.

The factors identified as deterrents to individuals seeking treatment with dental stem cells could potentially be mitigated by the establishment of reasonable fee structures that are comparable to those of other standardized management procedures.[16] Nevertheless, a positive outlook towards dental stem cell therapy was noted among 72.5% of participants. This indicates that, with appropriate education and training, the emerging generation of informed and aware dental students may play a constructive role in the community and provide patients with additional treatment options in the future.

A contemporary issue that merits attention is the emergence of threatening diseases that have proliferated globally, particularly the pandemic caused by SARS-CoV-2 and its associated complications, one of which is Mucormycosis. This condition has significant implications for the maxillofacial region, often resulting in the loss of critical anatomical structures that necessitate prosthetic rehabilitation and the application of stem cell therapies. The potential for stem cell interventions to serve as an innovative solution in this context is considerable; however, challenges such as insufficient awareness, knowledge deficits, and the lack of tooth banking have impeded progress. Consequently, the need for preparedness in this area is crucial. A recent review of the literature indicates that the increased incidence of viral infections and the prevalence of developmental defects in children are on the rise. These issues could potentially be addressed through the promotion of stem cell therapy, with dental stem cell therapies serving as a vital tool in helping society avert this crisis. Furthermore, the correlation between the increased incidence of viral diseases and the rise in developmental disorders underscores the importance of stem cell research as a significant treatment modality.

The 2017 guidelines established by the Indian Council of Medical Research (ICMR) seek to clarify the primary governmental regulations, institutional oversight, and communication about both basic and translational stem cell research.[17] These guidelines are especially pertinent given the regulatory ambiguities associated with stem cells and their therapeutic applications, as delineated in the 2017 national guidelines for stem cell research in India. Additionally, ethical considerations indicate that dental stem cells may represent a more favourable option, as they are linked to fewer restrictions and ethical dilemmas. This is particularly relevant in the context of dental stem cell treatment.

5. Conclusion

Dental stem cell therapy presents significant potential for transforming the field of dentistry by providing regenerative solutions for a range of oral and maxillofacial conditions. Although this therapy is still in the early stages of development, ongoing research and clinical trials are facilitating its prospective incorporation into standard dental practices. Nevertheless, it is essential to address challenges such as the standardization of protocols, the necessity for long-term efficacy studies, and the resolution of ethical concerns. As research advances, dental stem cell therapy may redefine our approach to tooth loss, periodontal diseases, and other dental disorders, ultimately enhancing patient outcomes and potentially influencing broader medical applications.

6. Source of Funding

None.

7. Conflict of Interest

There are no conflicts of interest.

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