



Knowledge and Awareness about the Importance of Stem Cells in Dentistry: A Survey

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: Stem cells, the hero of regenerative medicine, are self renewable and has the potential to regenerate. Dental stem cells have proven to be an excellent source for mesenchymal cells. Dental mesenchymal cells can be applied for the replacement of dental and oral tissues against various tissue-damaging conditions including dental caries and periodontitis as well as for systemic regulation of excessive inflammation in immune disorders, such as autoimmune diseases and hypersensitivity. In this study, a survey was conducted among the dental students of a private dental hospital regarding their awareness about stem cell therapy used in dentistry.

Materials and Methods: The study was conducted with the help of a questionnaire which was circulated with the help of social media and the internet. The target population were the dental practitioners and students of Saveetha Dental College. The questionnaire consisted of 15 questions that tested their knowledge and awareness regarding stem cell therapy in dentistry.

Results: A majority of the undergraduate dental students were aware of basics in stem cell therapy in dentistry. The majority were willing to practice regenerative therapy in future or invest for the same in one way or the other. The overall response of and the percent analysis were calculated for each question.

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Conclusion: It can be concluded that the dental students of Saveetha dental college have sufficient knowledge and awareness regarding dental stem cells. Practice of dental stem cell therapy may be a big step now but is definitely going to be an advantage in the future.

Keywords: *Mesenchymal stem cells; regenerative dentistry; tissue engineering; innovative technique; novel method.*

1. INTRODUCTION

Stem cells play an important role in dentistry as they are undifferentiated cells with the capability to produce different types of cells and treat diseases [1]. They are cells with the potential to develop into many different types of cells in the body. They serve as a repair system for the body. They are self renewable and can regenerate missing tissues. Teeth are said to be the most natural and noninvasive source of stem cells [2]. Various research on dental stem cells have opened the gate for new treatment protocols in the field of endodontics, periodontology and various oral and maxillofacial procedures [3]. There are two types of stem cells, namely, adult stem cells and embryonic stem cells. Dental stem cells are a type of adult stem cells. Owing to the regenerative properties of dental stem cells and their plasticity, they can be a good source of mesenchymal cells [3,4]. These mesenchymal cells play a significant role in organ development and postnatal repair. Though mesenchymal cells are regenerative they show immune-regulatory capacity and tropic activity. These features are important for the establishment of a regenerative micro-environment at the sites of tissue injury [5]. Mesenchymal cells secrete various bio active factors that inhibit apoptosis and scarring [6].

Dental pulp stem cells are found in the pulp and were first derived from permanent third molars of adult humans. Recently they have gained attention due to the number of research and their accessibility and the associated relatively low cost of integration into regenerative therapy. In India, the application and awareness of stem cells are still in the budding stage and hence more research needs to be done [7].

In dentistry, these human dental pulp stem cells have already been introduced for alveolar bone augmentation which is basically increasing the alveolar bone volume [8].

Adult stem cells have great potential for the regeneration of craniofacial structures and this can hence contribute to tissue engineering [9].

Craniofacial structures like mandibular condyle, calvarial bone, cranial suture, and subcutaneous adipose tissue have all been engineered from mesenchymal cells [10]. Long term preservation of these dental stem cells are being looked into [11]. Preservation of dental stem cells can be used for future personalised medication and treatment [12]. This mirrors the idea of banking umbilical cord blood [13].

It is often said that the oral cavity mirrors the rest of the body. Owing to the strong association between the oral health and overall health of an individual, advancements are being looked into in order to maintain teeth and oro facial bone to combat general decline in oral health. Though the use of dental implant and prosthodontics procedures are common and effective, they are expensive and can result in rejection or failure [13,14]. Recent research is shifting focus to regenerative medicine in dentistry. Use of the regenerative medicine in dentistry requires a proper knowledge about the different types of stem cells and their applications. In this study, a survey was conducted among the dental students of a private dental hospital regarding their awareness about stem cell therapy used in dentistry.

2. MATERIALS AND METHODOLOGY

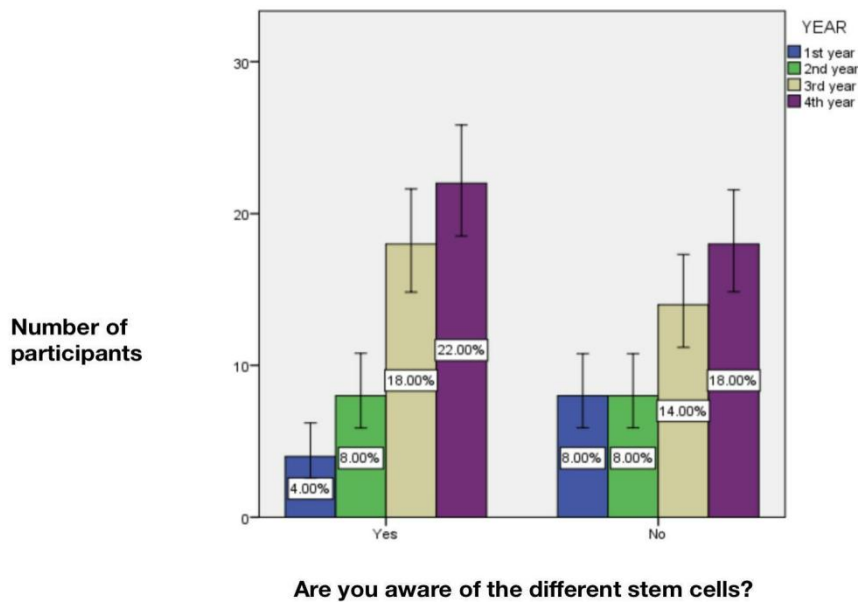
This cross-sectional study was conducted among the undergraduate students of Saveetha Dental College and Hospital, Chennai. To evaluate the knowledge of the participants about stem cells and their importance in dentistry, a self-administered questionnaire containing 9 questions was prepared. The questions revolved around the awareness of the dental students regarding the types of stem cells, stem cell banks, sources of dental stem cells, and their willingness to inculcate the practice of dental stem cell therapy. The questionnaire was validated and later distributed to the participants. A web-based questionnaire was also developed using Google forms and was circulated. The participation of the subjects was kept voluntary and nobody was not obligated to fill the form. Questions were answered with "yes" or "no" or by

marking the correct responses. Frequency analysis and percentage analysis were done with the obtained results. Data was recorded in Microsoft Excel and exported to the statistical package of social science for windows (SPSS) and subjected to statistical analysis. Descriptive statistics were done and Chi square tests are used for comparison.

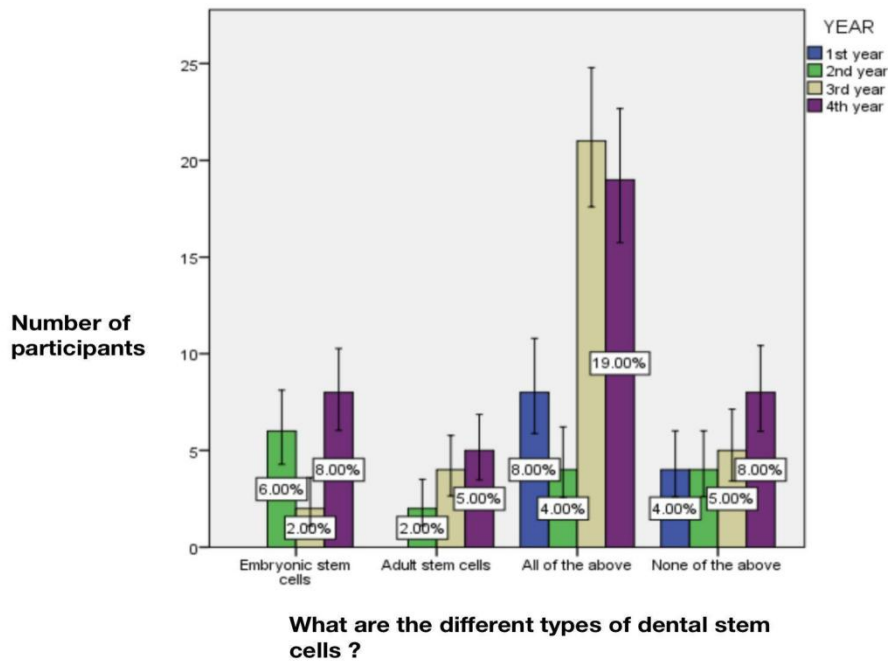
3. RESULTS

In this study around 150 responses were collected. The overall response and the percent analysis were calculated for each question. 4% of first year students, 8% of second year students, 18% of third year and 22% of final year students were aware about the different types of stem cells. Pearson chi square test shows p value is 0.639 (p value > 0.05) (Graph 1). Hence it is statistically not significant. 8% of first years and 4% of second years, 19% of third and final years were aware about adult stem cells and embryonic stem cells Pearson chi square test

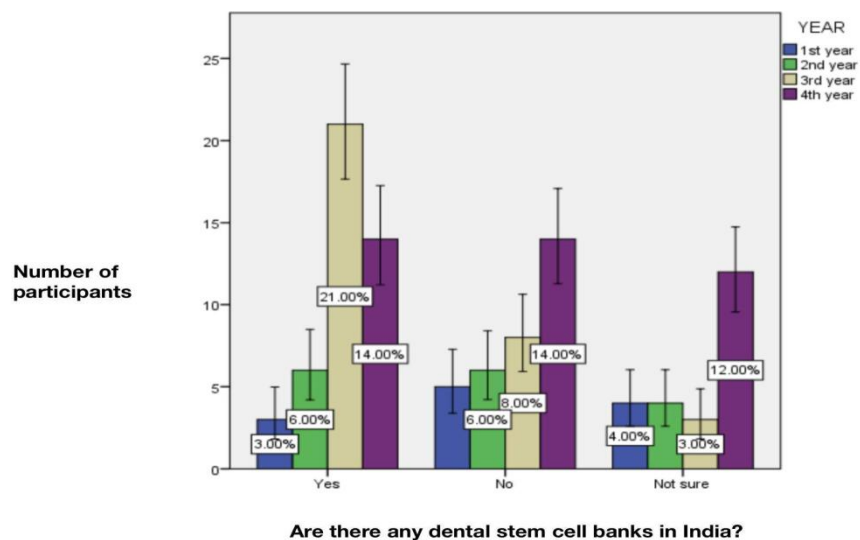
shows p value is 0.074 (p value > 0.05). Hence it is statistically not significant (Graph 2). 3% of first years, 6% of second years, 21% of third years and 14% of final years were aware that dental stem cell banks are present in India. Pearson chi square test shows p value is 0.223 (p value > 0.05). Hence it is statistically not significant (Graph 3). 3% of first years, 9% of second years, 16% of third years and 22% of final years were aware that dental stem cells can be retrieved from apical papilla of the tooth (Graph 4). 1% of first years, 8% of second years, 12% of third years and 17% of final years were aware that dental stem cells can be used to develop non dental tissues and organs (Graph 5). 6% of first years, 10% of second years, 21% of third years and 24% of final years are willing to practice stem cell based regenerative therapy in their practise (Graph 6). 4% of the first years, 6% of second years, 20% of third years and 23% of final years are willing to invest for dental stem cell banking (Graph 7).



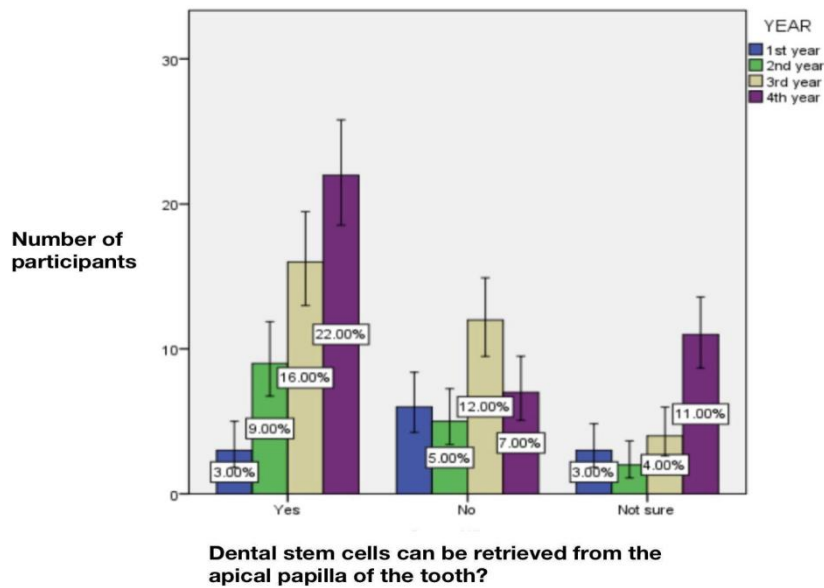
Graph 1. Graph represents the association between the awareness of different types of stem cells and the year of study. The X axis represents the awareness of different types of stem cells and the Y axis represents the number of participants belonging to different years of study. Blue denotes first years, green denotes second years, yellow denotes third years and purple denotes final year participants. 4% of first year students, 8% of second year students, 18% of third year and 22% of final year students were aware about the different types of stem cells. Pearson chi square test shows p value is 0.639 (p value > 0.05). Hence it is statistically not significant



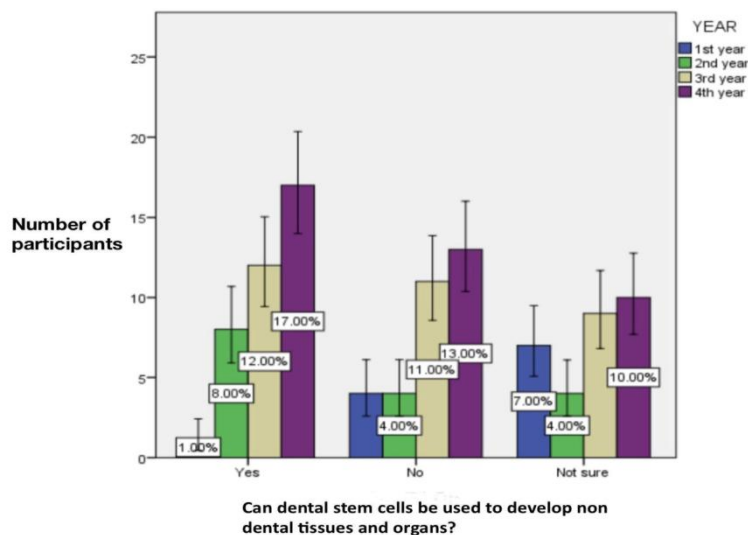
Graph 2. Graph represents the association between the knowledge on the different types of stem cells and the year of study. The X axis represents the different types of stem cells and the Y axis represents the number of participants belonging to different years of study. Blue denotes first years, green denotes second years, yellow denotes third years and purple denotes final year participants. 8% of first years, 4% of second years, 19% of third and final years were aware about adult stem cells and embryonic stem cells. Pearson chi square test shows p value is 0.074 (p value > 0.05). Hence it is statistically not significant



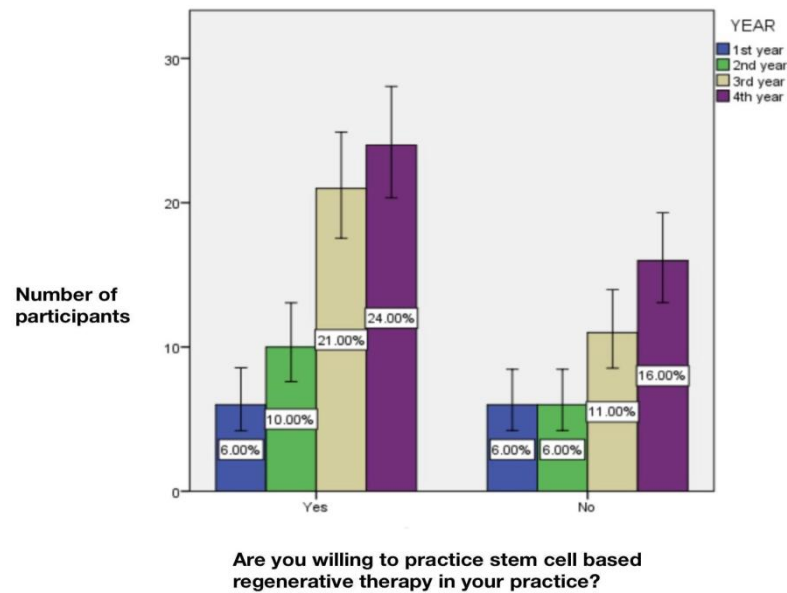
Graph 3. Graph represents the association between the awareness of participants regarding the dental stem cell banks in India and the year of study. The X axis represents the awareness of dental stem cell banks in India and the Y axis represents the number of participants belonging to different years of study. Blue denotes first years, green denotes second years, yellow denotes third years and purple denotes final year participants. 3% of first years, 6% of second years, 21% of third years and 14% of final years were aware that dental stem cell banks are present in India. Pearson chi square test shows p value is 0.223 (p value > 0.05). Hence it is statistically not significant



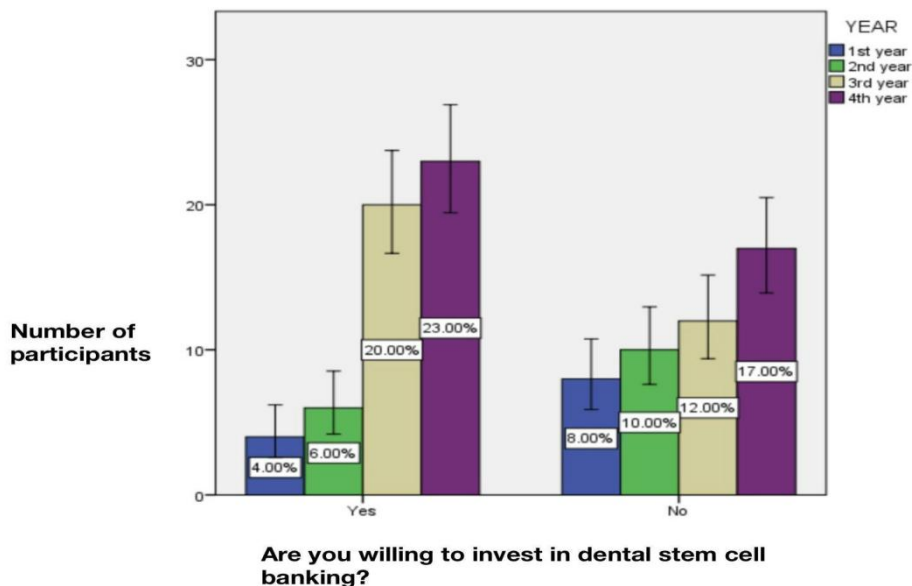
Graph 4. Graph represents the association between the awareness of students regarding dental stem cells being sourced from apical papilla of the tooth and the years of study. The X axis represents the awareness of students regarding dental stem cells being sourced from the apical papilla of the tooth and the Y axis represents the number of participants belonging to different years of study. Blue denotes first years, green denotes second years, yellow denotes third years and purple denotes final year participants. 3% of first years, 9% of second years, 16% of third years and 22% of final years were aware that dental stem cells can be retrieved from apical papilla of the tooth. Pearson chi square test shows p value is 0.369 (p value > 0.05). Hence it is statistically not significant



Graph 5. Graph represents the association between the awareness of students regarding dental stem cells being used to develop non dental tissues and organs and the year of study. The X axis represents the awareness of students regarding dental stem cells being used to develop non dental tissues and organs and the Y axis represents the number of participants belonging to different years of study. Blue denotes first years, green denotes second years, yellow denotes third years and purple denotes final year participants. 1% of first years, 8% of second years, 12% of third years and 17% of final years were aware that dental stem cells can be used to develop non dental tissues and organs. Pearson chi square test shows p value is 0.275 (p value > 0.05). Hence it is statistically not significant



Graph 6. Graph represents the association between the willingness of students to practice dental stem cell therapy and the different years of study. The X axis represents the willingness of students regarding the practice of dental stem cell therapy and the Y axis represents the number of students belonging to different years of study. Blue denotes first years, green denotes second years, yellow denotes third years and purple denotes final year participants. 6% of first years, 10% of second years, 21% of third years and 24% of final years are willing to practice stem cell based regenerative therapy in their practise. Pearson chi square test shows p value is 0.589 (p value > 0.05). Hence it is statistically not significant



Graph 7. Graph represents the association between the willingness of students to invest for dental stem cell banking and the year of study. The X axis represents the willingness of students regarding the investment of dental stem cell therapy and the Y axis represents the number of students belonging to different years of study. Blue denotes first years, green denotes second years, yellow denotes third years and purple denotes final year participants. 4% of the first years, 6% of second years, 20% of third years and 23% of final years are willing to invest for dental stem cell banking. Pearson chi square test shows p value is 0.188 (p value > 0.05). Hence it is statistically not significant

4. DISCUSSION

Stem cells in dentistry can help a great deal by helping the growth of new dental cells in a laboratory, it can help in the research causes of genetic defects in cells, research how diseases occur or why certain cells develop into cancer cells [15]. It can also test new drugs for safety and effectiveness [16]. The present survey was conducted among undergraduate dental students wherein around 150 students took the survey. The collected data was subjected to descriptive statistical analysis and chi square tests in SPSS.

This study reveals that the dental students showed the willingness to know about stem cell potential in dentistry which may be indicative of the acceptance of newer treatment modalities. Participants who believed that stem cell banking in dentistry were also willing to practice stem cell therapy in future. 4% of the first years, 6% of second years, 20% of third years and 23% of final years are willing to invest for dental stem cell banking. Although the majority of them believed that stem cell tissue regeneration will be advantageous in stem cell therapy, most were not sure whether these stem cells could be used to develop non-dental tissues or organs [17]. Only 1% of first years, 8% of second years, 12% of third years and 17 % of final years were aware that dental stem cells can be used to develop non dental tissues and organs. There are numerous applications of this progenitor cell such as continued root formation, regeneration of an immature tooth with extensive pulp damage, periodontal regeneration, biological tooth, and stem cell-based therapies.

Most of the participants of this survey seemed up to date with the current evolvments in the field of dentistry as they were able to answer most of the questions correctly. In a similar study conducted earlier by Epelman et.al it was found out that 56% of the participants had received continued education regarding stem cells in dentistry and hence had sufficient knowledge regarding the same [18]. However, those students were future endodontists when compared to the present survey were dental undergraduates were tested [19]. There is a need to spread awareness regarding these guidelines as the opinion of the dental residents may help to reframe them which in turn might facilitate the safety of procedures/treatment done using dental stem cells. Another study conducted by Utneja et.al showed that regenerative dentistry is a far better option than implant

dentistry and that maybe in about 20 years teeth can also be replaced using regenerative procedures. Currently only 23% of the dentists in the world use some type of regenerative procedures in their practice [20]. Future tissues like tissue engineered bone grafts, engineered joints and cranial sutures can be developed with stem cell therapy. Oral facial tissues have been identified as a source and therapeutic target for stem cells with clinical interest in dentistry. A team of professionals including stem cell biologists, molecular biologists, geneticists, polymer and materials scientists, mechanical engineers and clinicians with knowledge of oral and maxillofacial disorders is needed to develop the field of craniofacial tissue engineering. Our team has extensive knowledge and research experience that has translate into high quality publications [21-40]. Understanding the dental stem cells and the principle of tissue engineering will provide us a better knowledge on the different clinical treatment plans that can be established in future. Further studies on clinical effectiveness of dental stem cell therapies can be introduced based on current evidence-based methods in human patients.

5. CONCLUSION

From the above mentioned results, it can be concluded that the dental students have sufficient knowledge and awareness regarding the different types of dental stem cells. Practice of dental stem cell therapy may be a big step now but is definitely going to be an advantage in the future.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Appendix – Questionnaire

Knowledge And Awareness Of Stem Cell Therapy among Dental Students And Practitioners Of Saveetha Dental College

- 1. Stem cells are unspecialised type of cells which are capable of forming any cell type**
 - a. Yes
 - b. No
 - c. Not sure

- 2. Are you aware of the different type of stem cells?**
 - a. Yes
 - b. No

- 3. What are the different types of stem cells?**
 - a. Embryonic stem cells
 - b. Adult stem cells
 - c. All of the above
 - d. None of the above

- 4. Dental stem cells can be retrieved from apical papilla of the tooth**
 - a. Yes
 - b. No
 - c. Not sure

- 5. Are there any dental stem cell banks in India**
 - a. Yes
 - b. No
 - c. Not sure

- 6. Can dental stem cells be used to develop non dental tissues and organs?**
 - a. Yes
 - b. No
 - c. Not sure

- 7. Are you willing to practice stem cell based regenerative therapy in your practice?**
 - a. Yes
 - b. No

- 8. What do you think is the main obstacle to seek treatment with the aid of dental stem cells?**
 - a. High cost
 - b. Lack of awareness
 - c. Ethical issues
 - d. Insufficient knowledge among dental practitioners
 - e. Insufficient knowledge among people
 - f. Insufficient knowledge among both dental practitioners and people
 - g. All of the above

9. Are you willing to invest for dental stem cell banking?

- a. Yes
- b. No

10. Year of study

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