

Do you have an account in tooth bank ? A prospective study

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Abstract

Background: Stem cell research is expanding at a breakneck speed in the field of medicine, which provides a striking window of opportunity for restorative and regenerative applications. Stem cells are immature, unspecialized cells that have the ability to develop into many different cells via differentiation. Teeth are an innate source of stem cells. DPSCs have MSCs phenotype is and they have the potential to differentiate into several cell types, including odontoblasts, neural progenitors,

osteoblasts, chondrocytes and adipocytes. The aim of the present study was to assess the awareness and knowledge about dental stem cells and tooth banking among general public.

Materials and Methods: The study involved 150 participants. Based on inclusion and exclusion criteria the participants were recruited for the study. The questionnaire comprises of 15 questions. The responses obtained from the participants were statistically evaluated.

Results: The results of the study were statistically analysed and showed that majority of the population were familiar with dental stem cells and tooth banking. No difference was found in the level of awareness and knowledge among the population with respect to age, level of education and field of profession.

Conclusion: It is important to create awareness about DPSCs and tooth banking among general public, as procuring and storing stem cells from tooth is comparatively easier than other stem cell sources.

Keywords: Dental pulpal stem cells (DPSCs), Mesenchymal stem cells (MSCs), tooth bank, Stem cells from human exfoliated deciduous teeth (SHED).

Introduction

Stem cell research is expanding at a breakneck speed in the field of medicine, which provides a striking window of opportunity for restorative and regenerative applications. Stem cells are immature, unspecialized cells that have the ability to develop into many different cells via differentiation. Tooth banking is a process of storing dental pulpal stem cells that have the ability to regenerate into various cell types. Dental stem cells are unspecialized, continuously multiplying cells having the capacity to differentiate into specialized cells of one or more types.¹ Stem cell therapy offers multiple benefits in the modern science world.² Mesenchymal Stem Cells (MSCs) isolated from human dental tissues includes dental pulpal SCs (DPSCs) in human permanent teeth, Stem cells from human exfoliated deciduous teeth (SHEDs), Periodontal ligament SCs (PDLSCs), and Dental follicle SCs (DFSCs) and apical papilla from human third molar. Of all, Dental Pulpal stem cells (DPSC) and Stem cells from human exfoliated deciduous tooth (SHED) were identified first. DPSC are mesenchymal stem cells found in the pulp of adult permanent teeth.³ SHED are stem cells found in the

exfoliated milk teeth of children. Recent studies have shown that these cells have the ability to develop into one or more types of bodily tissues than any other types of stem cells.⁴ They can proliferate and differentiate into neuronal cells, adipocytes and odontoblasts and can form alveolar and orofacial bone for tissue regeneration.¹ Researches on adult wisdom teeth stem cells is paving way for novel dental treatments in endodontics, periodontal and oral-maxillofacial procedures.⁵

Advantages of dental stem cells:

- a) The plasticity of dental pulpal stem cells makes them a major source of mesenchymal stem cells in dental regenerative procedures.
- b) DPSCs possess multiline age differentiation i.e they can differentiate into ectodermal and endodermal lineages apart from mesodermal lineage.
- c) They are readily accessible and available than embryonic SCs.
- d) Easy to collect and inexpensive to store.
- e) Higher regenerative potential than the bone marrow derived mesenchymal stem cells.
- f) Non- invasive method of isolation using routine clinical procedure
- g) Increased proliferative capacity
- h) Limited ethical concerns^{1,5,6}

They have the capacity to regenerate bone, periodontal ligament, formation of dentin- pulp complex in vivo and also reconstruction of tooth by cryopreservation.^{1,6} Currently, stem cell therapy provides successful treatment of various medical conditions and diseases such as; cerebral ischemia, Parkinson's disease, Alzheimer's disease, retinal disease, diabetes type 1 and 2, myogenic disease, neuronal, cardiovascular and in bone regeneration. Thus, human teeth can serve as an excellent tool for stem cell therapy.^{6,7,8} Owing to the advantages cited, this study was carried out in order to find out the

awareness and knowledge about dental stem cells and the concept of tooth banking among general public.

Materials and Methods

The study involved 150 individuals of age within 18 – 50 years. The participants were randomly selected based on the inclusion and exclusion criteria. A google form-based questionnaire was prepared comprising of 15 questions. Selected individuals were asked to fill the prepared questionnaire. The purpose of the study and the procedure were clearly explained to the study population. The individuals were also explained about their information being kept confidential and the data being used is solely for the research purpose and eventually be published in general. The responses obtained from the participants were then statistically evaluated.

Inclusion Criteria

1. All educated people below 50 years of age

Exclusion Criteria

1. Unscholarly individuals
2. Individuals above 50 years of age.

Results

The present study was done to assess the knowledge of general public about tooth banking. The survey was conducted among 150 individuals aged within 18 – 50 years of which 36% (n=55) of the population were health care professionals and 63% (n=95) of the population were non – health care professionals. The health care professionals comprised of dental and medical undergraduate and post graduate students. The non – health care professionals comprised of literates from various other fields.

The questionnaire was framed with a total of 15 questions and it was divided into 3 domains.

Domain 1: A set of questions related to awareness about stem cells in general.

Domain 2: A set questions to evaluate the awareness about dental stem cells.

Domain 3: A set of questions pertaining to storing of stem cells and tooth banking. All the responses were converted into codes and were statistically analysed using SPSS 20.0.

Majority of the population (85%) were found to be aware of stem cells in general (Figure 1). But, hardly few percent of population (8%) have claimed that they have stored the stem cells (Figure 2). When the participants were questioned about the potential sites for stem cells in the body, almost half of the people (51%) answered that stem cells can be taken from bone marrow, teeth and umbilical cord, 31% of the people answered only umbilical cord and 18% of the people answered only bone marrow as site for stem cell harvesting (Figure 3). Pretty much all people (89%) were aware that storing stem cells is exceptionally efficacious (Figure 4). When the participants were asked whether stem cells can be procured from tooth or not, 36% of the people answered affirmatively, 18% answered no, 21% opted maybe and 25% had no clear idea (Figure 5).

Figure 1

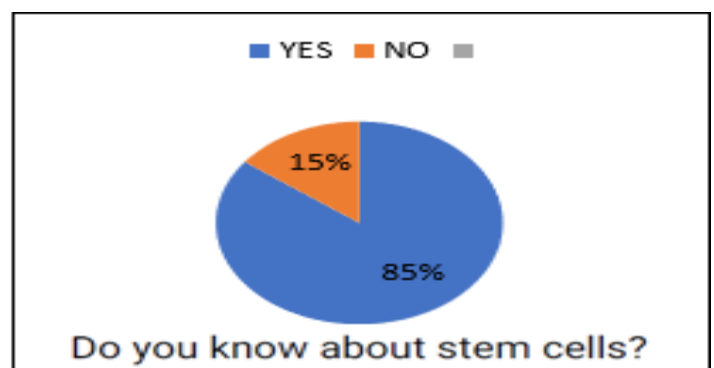


Figure 2

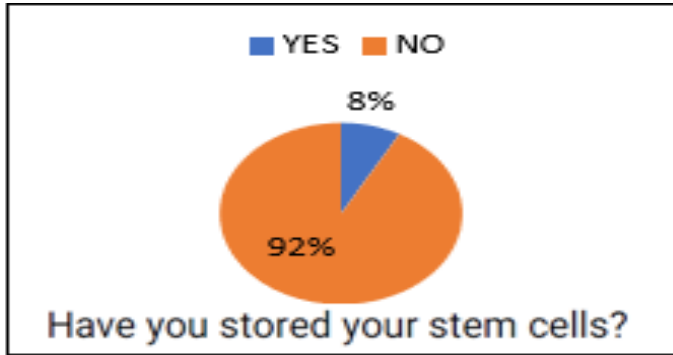


Figure 3

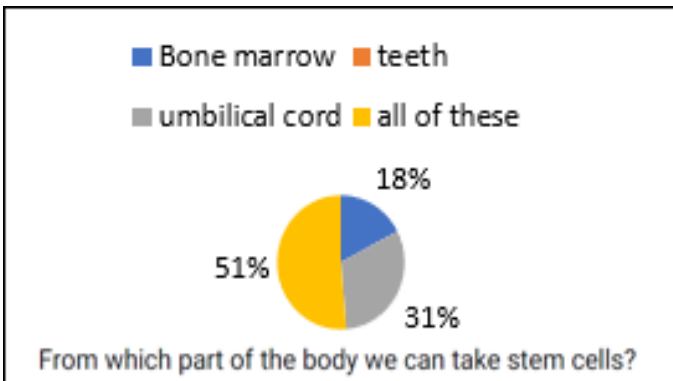


Figure 4

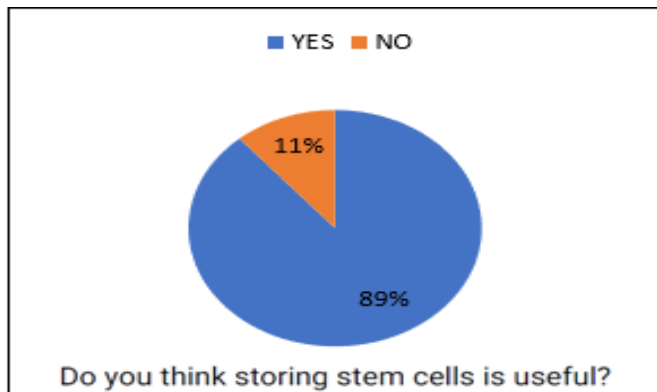


Figure 5

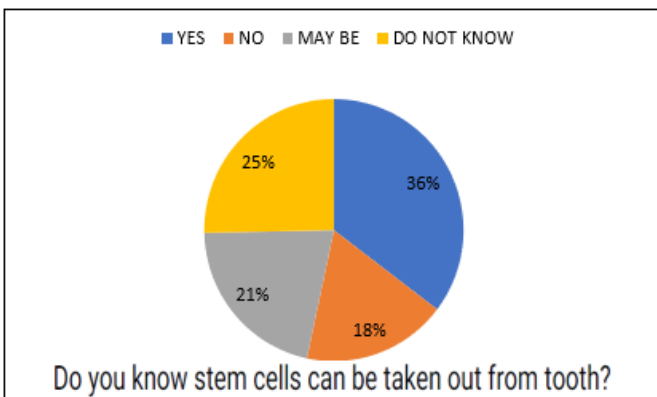
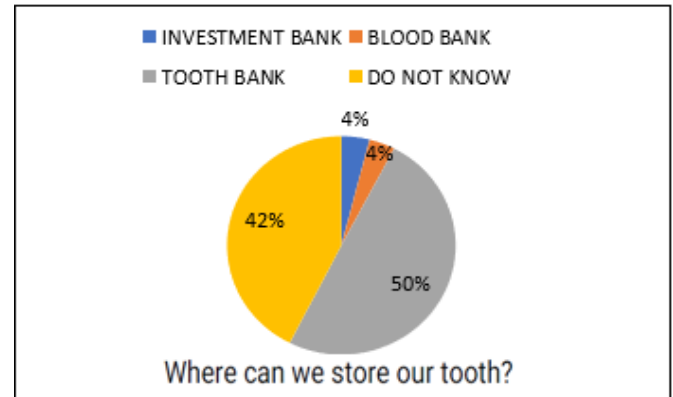


Figure 6



About 50% of the participants were aware that dental stem cells can be stored in tooth banks, 4% answered investment bank, 4% answered blood bank, rest of the population (42%) had no clear idea (Figure 6). The stem cells procured from parent can be used for their children. Nearly half of the population (44%) were unaware about this fact as they opted “do not know”, 38% answered yes and 18% answered no (Figure 7). About 35% of the population replied that stem cells can be taken from both deciduous and wisdom tooth, 20% replied baby tooth, 11% replied wisdom tooth and the rest of the population opted do not know (Figure 8).

The main application of stem cells was found to be regenerative medicine (45%) followed by oral surgery (12%), dental cavity removal (10%) and (33%) had no idea (Figure 9). The responses obtained for the age at which tooth storage can be started were 45% above 5 years, 13% above 20 years, 4% above 50 years and 40% had no clear idea (Figure 10). The individuals were asked why dental stem cell storage is more preferred. About 51% responded that procurement of dental stem cells is affordable and less invasive, 5% responded that dental stem cells can be stored at home, 7% thought it would be expensive and 31% had no idea (Figure 11).

Figure 7

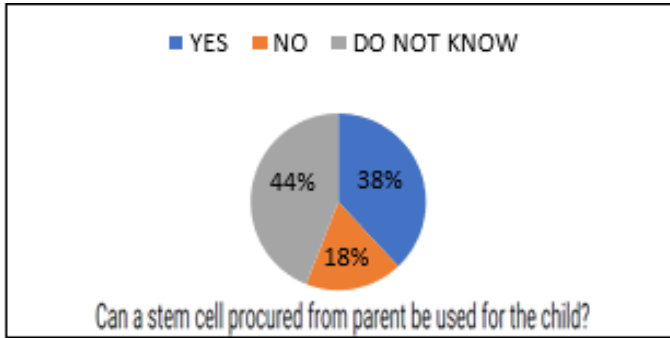


Figure 8

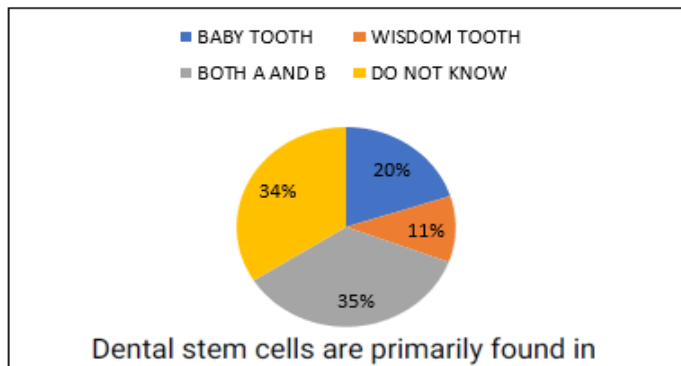


Figure 9

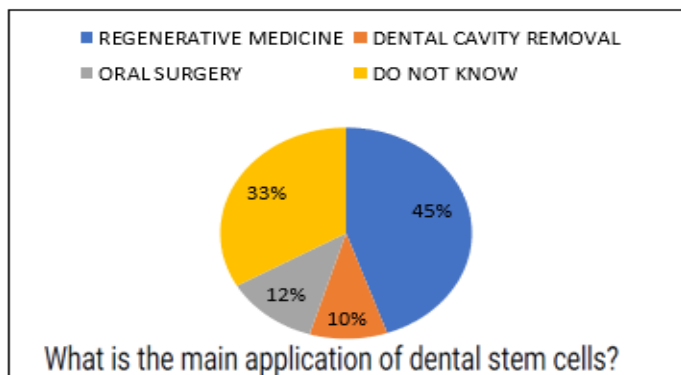


Figure 10

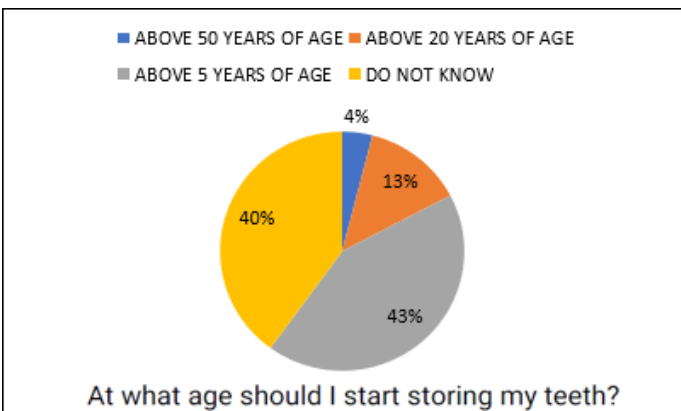


Figure 11

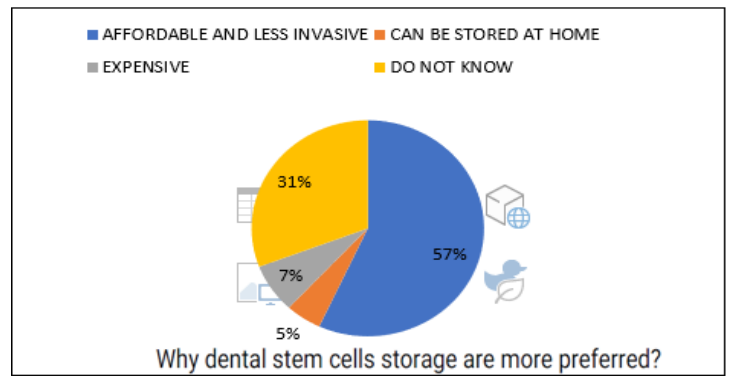


Figure 12

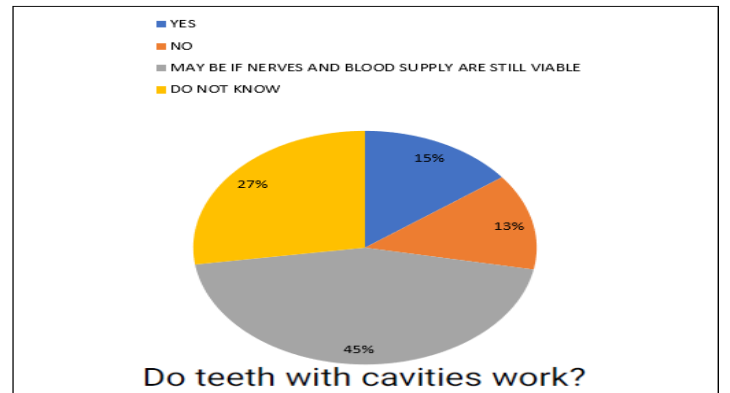


Figure 13

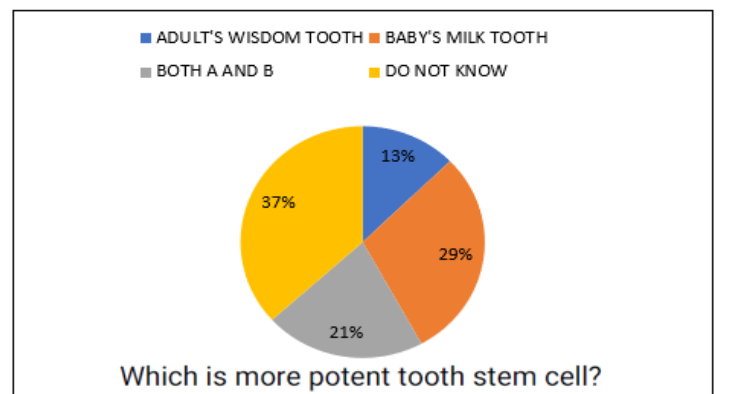


Figure 14

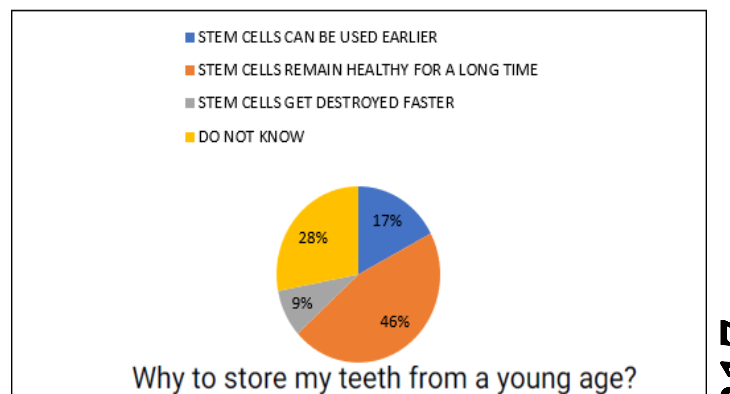
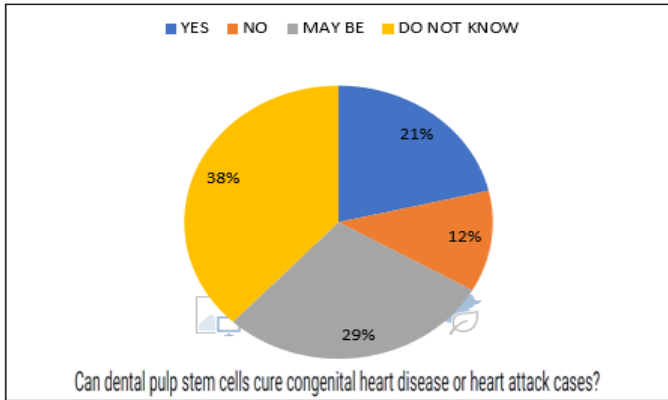


Figure 15



When the participants were asked whether teeth with cavities can be used. 15% answered yes, 13% answered no, 45% answered only if nerve and blood supply are still viable and 27% answered had no idea (Figure 12). The more potent tooth for stem cell was found to be baby’s milk tooth (29%) followed by both milk tooth and adult wisdom tooth (21%) and adult wisdom tooth only (13%). About 37% had no idea (Figure 13). On recording the reasons for storing teeth from young age, 46% replied

stem cells can remain healthy for a long time, 17% replied stem cells can be used earlier, 9% replied stem cells can be destroyed faster and 28% had no idea (Figure 14). About 21% of the population agreed that stem cells can cure congenital heart diseases whereas 12% denied the fact, 29% opted maybe and 28% had no clear idea (Figure 15).

On comparing among health care and non- health care professionals, there was no significant difference in the level of knowledge between the two groups. P value= 0.505 (Table 1). Kruskal Wallis test was performed to find out the association between age and the level of knowledge among the population, which revealed no significant difference. P value= 0.8 (Table 2). Similarly, there was no significant difference obtained between the level of education and knowledge about dental stem cells and tooth banking. P value = 0.33 (Table 3)

Table 1: Level of knowledge among health professionals and non- health professionals (Mann Whitney test)

Field of profession	Domain 1	Domain 2	Domain 3	Total knowledge
	Mean ± SD			
Non- health care professionals	2.5±0.8	2.0±1.6	2.8±1.5	7.4±3.4
Healthcare professionals	2.7±0.8	2.1±1.4	2.9±1.2	7.8±2.8
P value	0.2	0.74	0.60	0.505

P≤0.05 is statistically significant

Table 2: Association between age and level of knowledge (Kruskal Wallis test)

Age	Domain 1	Domain 2	Domain 3	Total knowledge
	Mean ± SD			
Less than 20	2.6±0.8	2.1±1.5	2.8±1.3	7.5±3.2
20-35	2.6±0.7	2.1±1.5	2.7±1.3	7.5±2.9
Above 35	2.7±0.9	2±1.4	3±1.7	7.7±3.6
P value	0.5	0.9	0.6	0.8

P≤0.05 is statistically significant

Table 3: Association between level of education and knowledge

Level of education	Domain 1	Domain2	Domain3	Total knowledge
	Mean ± SD			
School	2.5±0.8	2.0±1.6	2.7±1.4	7.2±3.4
College	2.7±0.8	2.1±1.4	2.9±1.4	7.8±3.1
P value	0.29	0.52	0.44	0.33

P≤0.05 is statistically significant

The above results clearly indicates that there exists an equal distribution of awareness and knowledge about dental stem cells and tooth banking among the participants regardless of their age, level of education and field of profession whether health care or non- health care profession.

Discussion

Stem cells are immature, unspecialized cells that have the ability to develop into many different cells via differentiation.¹ Dental pulp has proved to be an effective stem cell source due to its high proliferation, multi-differentiation, high viability and being beneficial for cellular therapy in various diseases such as neurological disease, circulatory disease, diabetes, liver disease, ophthalmological disorders, cardiac diseases, immune disease, and oral disease.^{6,7,8} Furthermore, the methods of acquiring and preserving dental pulpal stem cells seems to be less invasive, more convenient and user-oriented which makes it more affordable.^{1,3} Hence the present study, was performed to assess the awareness about dental stem cells and tooth banking among general public. Our study revealed that majority of the study population (85%) were familiar with stem cells in general and about half of the population (51%) were acquainted with the various body sites to procure them. A considerable percentage of the participants (38%) were aware that parents stem cells can be used for the child. However, many (44%) were uncertain of this fact.

Stem cell storage means collection and cryopreservation of stem cells from umbilical cord, blood and tissue for future use in stem cell treatments or clinical trials.⁹ In our study, very few people (8%) have claimed that they have stored the stem cells. This difference indicates a lack of drive among the people to volunteer stem cell storage and banking despite having fair knowledge about it, which highly implies the need to take necessary measures to increase the awareness as well as the execution.

Regarding the attitude towards dental stem cells, our study revealed substantial percentage of the population (36%) agreed that teeth can serve as a source of stem cells. About 35% of the population knew that dental stem cells can be procured from both deciduous and wisdom tooth and 29% of the population were aware that milk tooth can be more potent for stem cells. Almost half of the participants (45%) agreed that teeth affected with cavities can be used for stem cell procurement if the nerve and blood supply are maintained intact.

Almost half of the population (45%) considered regenerative medicine as the chief application and further 21% of the population agreed that dental stem cells can be used in congenital heart diseases. A similar study by Jose N in 2018 conducted among the people of dentistry, revealed that majority of them (79.7%) were aware of the therapeutic applications of DPSCs. His study also stated that only few dentists (15.1%) have explained about the application of stem cells in dentistry and convinced their patients to store the tooth.¹⁰ This reveals that the awareness and knowledge about dental stem cells among

the participants was adequate but was less compared to that of stem cells in general.

Tooth banks are company which provide a wide-ranging key for banking dental stem cells. The first tooth bank was established in Hiroshima, Japan in 2004. Today tooth banks are prevalent throughout the world owing to the development in marketing field.¹¹ “Mothercell” and “Store your cells” are tooth banking companies present in India.¹² Present study revealed that majority of the study participants (89%) agreed that storing stem cells is extremely efficacious. About 50% of the study population were aware that dental stem cells can be stored in tooth banks and about 51% of population considered that procuring dental stem cells is less invasive and affordable. Katge et al in 2017 in his study, found that more than 50% of the study population were unaware of tooth banks in India,¹¹ which was similar to our study. An earlier stated study by Jose N, have found that majority of the study population (79.1%) were not aware of tooth banks in India.¹⁰ This indicates the need to inculcate the awareness about tooth banks and its role among the population.

The steps in tooth banking process involves collection of the exfoliated or extracted teeth, transporting it in a suitable medium, isolation and preservation of stem cells followed by cryopreservation. Cryogenically preserved stem cells have no expiration date and can be stored indefinitely.^{1,12} About 46% of the participants accepted that stem cells can remain healthy for a long duration of time.

A study by Basson et al in 2016, reported that the people in the field of dentistry and medicine were more updated with the latest research techniques and also about the importance of the tooth banking when compared with the people in other fields.⁵ But the present study showed an equal distribution of awareness and knowledge about

dental stem cells and tooth banking among the participants regardless of their age, level of education and field of profession. This can be attributed to reasons such as improved curriculum in schools and colleges, ease of access to internet and other social media platforms.

Conclusion

Days are gone where the extracted teeth were considered as a medical waste. The emergence of newer diseases and the search for better cure constantly poses the need for advancement in treatment modalities. Stem cell therapy is one such major tool in the field of regenerative dentistry. Hence, it is essential to create awareness about DPSCs and tooth banking among general public, as procuring and storing them is comparatively easier than from other stem cell sources. The data from our study overall revealed that participants were very much familiar about dental stem cells and tooth banking with an equal distribution of knowledge and awareness among the population. However, lacunae still prevail concerning its practical implementation. Incorporation of training programmes for dental and medical professionals and conducting public awareness campaigns and advertisements for general public about tooth banking will foster the awareness more.

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