



STEM CELLS - FUTURE OF DENTISTRY!!

Dental Science

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ABSTRACT

Background: Dental stem cells are the stem cells obtained from teeth and its surrounding tissues. Dental stem cells are the most non-invasive and convenient source for collecting stem cells.

Aim: This study is approached to assess and compare the awareness of the uses of the dental stem cells among the dental students and dental practitioners.

Methods and Materials:

Settings and Design: A descriptive cross-sectional study.

A sample size of 260 was collected which includes 113 practitioners and 147 students using simple random sampling method. The primary data were collected using questionnaire method consisting of 26 questions.

Statistical analysis: Software SPSS version 18, Chi-square test/Fishers exact test was used.

Results: The awareness among the practitioners regarding dental stem cells is greater (90.9%, n=100) when compared to students (77.5%, n= 110). The P-value being 0.05.

Conclusion: Practitioners are more aware of stem cells when compared to the students.

KEYWORDS

Stem cells, Dental stem cells Dentistry, Awareness, Tooth banks.

Introduction:

Stem cells are immature undifferentiated biological cells that have the capacity to differentiate into specialized cells. Stem cells can be accessible from sources like bone marrow, adipose tissue, blood, umbilical cord and also from teeth.^{[1][2]} Stem cells are used to cure various types of diseases or conditions such as Parkinson's disease, heart diseases, Diabetes, cancer, diseases of nervous system, Alzheimer's disease etc.^[1] In the field of dentistry, the use of dental stem cells is a good therapeutic approach in treating various conditions like alveolar bone resorption due to loss of teeth, extraction or trauma. It may also be used in cases of root fractures, pulpal necrosis due to caries or even replacement of tooth.

Dental stem cells can be obtained more easily and conveniently. Dental stem cells include dental pulp stem cells, stem cells from human unfoliated deciduous teeth, periodontal ligament stem cells, stem cells from the dental follicle and apical papilla, tooth germ progenitor cells, oral epithelial stem cells and periosteum-derived stem cells.^[3] The use of dental stem cells for its regenerative capacity is a rapidly expanding field and gives a promising scope to the future of dentistry.

Aim and Objectives:

Aim: To assess and compare the awareness of dental stem cells among the dental students and practitioners.

Objectives:

- To assess and compare the awareness regarding the dental stem cells among the dental students and practitioners.
- To describe the variations in the views of dental students and practitioners.
- To identify and analyze the percentage of practitioners who are aware of tooth banking.

Method and Materials:

A descriptive cross-sectional survey was conducted from July 2017 - September 2017. A total of 200 final year BDS students and about 400

dental practitioners are present in the city of Visakhapatnam. Among them, a sample size of 260 was collected which includes 113 practitioners and 147 dental students. Sample selection was accomplished by simple random sampling method.

The primary data was obtained using questionnaire method. This method is adapted to know the awareness and the attitude of students and practitioners regarding the use of stem cells in dentistry.

The questionnaire (Refer) consists of 26 questions, which are closed-ended. The first 12 questions are based on general awareness of stem cells. The questions 13 to 16 are based on the use of stem cells in dentistry. The questions from 17 to 21 are focused on the condition of the tooth to be selected for obtaining dental stem cells. The last 5 questions, 22 to 26 were framed considering the knowledge level of practitioners.

Statistical analysis:

The questionnaire data were entered in Microsoft Excel 2010. All the analysis was done using SPSS version 18. A *P*-value less than 0.05 were considered statistically significant. The Chi-square test/Fishers exact test was used to compare the data and determine the statistical significance.

Results:

Out of 260 individuals who have responded, 57% are students and 43% are dental practitioners. Most of the students and practitioners have heard or read about the stem cells.

About 91% of dental practitioners are aware of dental stem cells when compared to students which are about 77% with a significant *P*-value of 0.005. 86% of practitioners are aware of the presence of stem cells in adults whereas it is only 62% among students.

Majority of students and practitioners are cognizant that stem cells are present in the umbilical cord, blood and bone marrow as well as in pulp and PDL, which can be stored for future purpose. 66% students have

heard or read about cases who were benefited by stem cells and it is 51% among practitioners.

Both the groups of individuals did not take the initiative to store stem cells. But they are equally aware that their stem cells can be used for their family members.

The awareness of the uses of stem cells in dentistry is more among practitioners (79%) when compared to students (66%) with a significant *P*-value of 0.032. Both the groups have a hypothetical view that the stem cells can regenerate pulp but are not certain of it.

The knowledge about the tooth banks is higher among practitioners (68%) than students (47%) with a significant *P*-value of 0.001.

62% of students and 65% of practitioners estimated that molars are the best tooth for storage of stem cells. 85% of students and 78% of practitioners stated that carious tooth cannot be used for the storage of stem cells. 79% of practitioners are aware that therapeutically extracted tooth can be used for storage of stem cells, whereas only 57% of students are aware of this fact, with a significant *P*-value less than 0.001.

Regarding the storage of dental stem cells of HIV carriers, both practitioners and students contradicted it. Majority of the students chose option "A" (15-20 years) as the shelf life of stem cells whereas the majority of practitioners chose options from B to D (ranging from 25 years). 74% of students and 79% of practitioners considered stem cells therapy to be safe.

90% of students and practitioners suggest that stem cell research should be a part of the dental curriculum.

69% of students support the dental stem cell storage in dental clinics whereas only 53% of practitioners agree to this concept, with a significant *P*-value of 0.009.

Discussion:

Stem cells are immature undifferentiated cells that are characterized by self-renewal and that capacity to differentiate into any mature specialized cell type. Stem cells are of two types, embryonic stem cells, and adult stem cells.^{[2][4]} Embryonic stem cells are imitative from embryos that are 2-11 days old, known as blastocysts. Adult stem cells are undifferentiated cells that occur in a differentiated tissue. They can be harvested from blood, bone marrow, umbilical cord blood, brain, eye, skeletal muscles, the lining of GIT, pancreas, skin, liver, placenta, adipose tissue, synovial membrane, amniotic fluid and dental pulp.^{[1][2]} Dental pulp is the soft tissue present in our teeth. Dental pulp contains stem cells known as dental stem cells.

The adult stem cells can renew itself and differentiate to yield some or all of the major specialized cell types of tissues or organs. The present study shows that the practitioners are more aware of dental stem cells than students (Refer). It also shows that 87% of practitioners are cognizant that stem cells are present even in adults whereas only 62% of students are known about the fact (Refer). This variation may be due to the amendment of the knowledge of the practitioners by attending various workshops and CDE programs.

According to the study, the number of students who have heard or read about cases benefited by stem cells is more compared to the practitioners (Refer). This may be due to the advanced technology which enhances students accessibility to information. This may be also due to the generation gap, as the uses of stem cells have been popularized the last few decades.

Stem cells are used in dentistry to treat various conditions like alveolar bone resorption, root fractures, pulpal necrosis or even replacement of tooth. They can also be used for treating medical conditions like muscular dystrophy, Crohn's disease, multiple sclerosis, PDL disease, sports injuries, cosmetics, anti-aging applications, Alzheimer's disease, Parkinson's disease, cranial and peripheral nerve repair and spinal injuries.^{[1][5][6][7]}

Dental stem cells can be stored by cryopreservation and magnetic freezing techniques in specialized banks called tooth banks.^[8] First tooth bank was established in Japan in Hiroshima University and the company was named as "Three brackets" in 2005. The study showed

that practitioners are more aware of the use of stem cells in dentistry than students (Refer), as well as only 47% of students are conscious about tooth banks when compared to 68% of practitioners (Refer). The decreased percentage of students may be due to the lack of knowledge about stem cells and their banking, as these topics are not a part of the dental curriculum. According to the study given by Basson et al, dentists felt that dental regenerative procedures must be reintroduced in the undergraduate dental curriculum.^[9]

A tooth may be considered healthy for storage of stem cells if it has an intact blood supply and is free of infections, caries or other pathologies. Ideal tooth for storage of stem cells includes deciduous incisors/canines, over retained deciduous molars, developing third molars, permanent molars and bicuspid extracted for the orthodontic purpose.^[10] The stem cells derived from human exfoliated deciduous tooth have greater ability to develop into various types of body tissues compared to other types of stem cells.^[11]

In this study, the majority of students and practitioners opted molars as the ideal tooth (Refer). Molars may be opted considering their increased root surface area and their complex anatomical structure. The study also revealed that a number of practitioners were known about the fact that therapeutically extracted teeth can be used for stem cell storage, compared to the students (Refer), which clearly indicates that students are less equipped about the knowledge of dental stem cells.

Banking of stem cells began in 1994. The study states that majority of students considered shelf-life of stem cells to be less than 20 years, whereas the majority of practitioners considered it to be more than 20 years (Refer). This variation is due to the improvisation of knowledge about the recent advances among practitioners, as mentioned earlier. Stem cell banking has been in existence for 23 years. There is no scientific data available to prove that stem cells can be stored longer than that period.

Considering the promotion of stem cell storage in clinics, 69% of students support the statement, whereas only 53% of practitioners are supportive. This difference in the opinions may be due to the lack of experience and practical knowledge among students. The increased number of practitioners opposing this idea may be due to the fact that introduction of stem cells in dentistry for its regenerative capacity, may affect the career of a dentist. The economical and storage constraints in the clinical setup of the practitioners play a major role in their opposition for storage of stem cells in clinics.

Recent findings and scientific research articles support the use of mesenchymal stem cells autologously within teeth and other accessible tissue harvested from oral cavity without immune-rejection.^[11] As per the study conducted by S. Gronthos et al, dental pulp stem cells were capable of forming ectopic dentin and associated pulp tissue in vivo in animals.^[12]

Currently, dental stem cells research focuses on the regeneration of dentin, pulp, and teeth, alveolar bone, regeneration of PDL after PDL diseases, salivary gland regeneration after radiation therapy, repair of craniofacial defects and treatment of lichen planus.^[13]

Conclusion:

The data from the study reveals that practitioners are more aware of the stem cells when compared to students. However, the only smaller number of practitioners are ready to promote dental stem cell banking in clinics when compared to the students. This variation may be due to the consideration of the regenerative capacity of stem cells among practitioners. As the uses of stem cells progress in dentistry with advanced technology, it may even be possible to replace a tooth in the future which results in decreased dental morbidity, thus seriously affecting the career of dental practitioners.

However, considering the vast potential benefits of stem cells, the dentistry can be made simpler and effective by their use. Dental stem cell storage will not only be helpful to dentistry but also enables us to use for other medical conditions when required, thus providing a promising and secure solution to various medical and dental problems. Hence, the promotion of tooth banks must be enhanced by creating awareness among the people by education and motivation.

So, to conclude, in spite of limited sample size the present study

showed positive results in the knowledge of stem cells. So the recommendations for future for overcoming the limitations in application of stem cells should include.

1. Education of students about stem cells and their applications by including these topics in the dental curriculum.
2. The ideology behind the tooth banking and its benefits must be promoted through IDA conferences.
3. A minimum number of 2 to 3 clinics must be established within a city and the process of tooth banking must be made cost-effective.

By taking into consideration of above recommendations, stem cells may prove to be an emerging trend in dentistry for regeneration of the damaged tissue structures.

Contribution Details:

	Contributor 1	Contributor 2	Contributor 3	Contributor 4	Contributor 5	Contributor 6
Concepts	✓	✓	✓		✓	✓
Design	✓		✓	✓	✓	✓
Definition of intellectual content	✓	✓	✓			✓
Data acquisition	✓	✓	✓	✓	✓	
Data analysis		✓	✓	✓	✓	✓
Statistical analysis	✓					
Manuscript preparation	✓	✓		✓	✓	✓
Manuscript editing	✓	✓	✓	✓	✓	✓
Manuscript review	✓	✓	✓	✓	✓	✓
Guarantor	✓	✓	✓	✓	✓	✓

Table-1: Knowledge regarding stem cells between dentists and students:

		Group				P-value
		Students		Practitioners		
		N	%	N	%	
Q3	Yes	110	77.5	100	90.9	0.005; Sig
	No	32	22.5	10	9.1	

Table-2: Awareness regarding the presence of stem cells in adults among students and practitioners:

		Group				P-value
		Students		Practitioners		
		N	%	N	%	
Q4	Yes	87	61.7	96	85.7	<0.001;Sig
	No	54	38.3	16	14.3	

Table-3: Percentage of students and practitioners who are aware of cases benefitted by stem cells:

		Group				P-value
		Students		Practitioners		
		N	%	N	%	
Q10	Yes	97	66.4	57	50.9	0.012; Sig
	No	49	33.6	55	49.1	

Table-4: Awareness about the uses of stem cells in dentistry among students and practitioners:

		Group				P-value
		Students		Practitioners		
		N	%	N	%	
Q14	Yes	97	66.4%	88	78.6%	0.032; Sig
	No	49	33.6%	24	21.4%	

Table-5: Awareness of tooth banks among students and practitioners:

		Group				P-value
		Students		Practitioners		
		N	%	N	%	
Q16	Yes	65	47.1	76	68.5	0.001; Sig
	No	73	52.9	35	31.5	

Table-6: Comparison between students and practitioners based on tooth opted for storage:

		Group				P-value
		Students		Practitioners		
		N	%	N	%	
Q17	NR	13	8.8	9	8.0	0.015; Sig
	a	13	8.8	8	7.1	
	b	25	17.0	8	7.1	
	c	5	3.4	14	12.5	
	d	91	61.9	73	65.2	

Table-7: Comparison between students and practitioners regarding the knowledge of therapeutically extracted teeth usage for extracting stem cells:

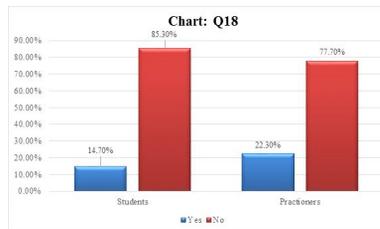
		Group				P-value
		Students		Practitioners		
		N	%	N	%	
Q20	Yes	97	69.3	59	53.2	0.009; Sig
	No	43	30.7	52	46.8	

Table-8: Opinion about the shelf life of stem cells:

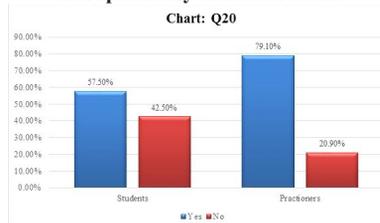
		Group				P-value
		Students		Practitioners		
		N	%	N	%	
Q22	NR	15	10.2	6	5.4	0.003; Sig
	a	47	32.0	15	13.4	
	b	26	17.7	30	26.8	
	c	25	17.0	28	25.0	
	d	34	23.1	33	29.5	

Bar Graphs:

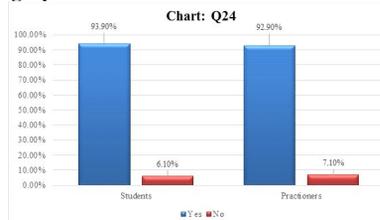
Bar graph-1: Comparison of opinions regarding the use of carious tooth for storage of stem cells:



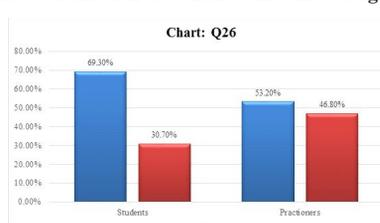
Bar graph-2: Comparison of views regarding the use of therapeutically extracted tooth:



Bar graph-3: Role of stem cells in future dentistry:



Bar graph-4: Promotion of dental stem cells storage in clinics:



Appendix:

STEM CELLS.....Future of Dentistry or not.....?

1. Have you read or heard about stem cells?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
2. Do you know what are stem cells?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
3. Do you know what are dental stem cells?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
4. Do you know that stem cells are present even in adults?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
5. Do you know where stem cells are present in our body?	A. Umbilical cord C. Pulp and PDL	<input type="checkbox"/> B. Blood and bone marrow <input type="checkbox"/> D. All the above	<input type="checkbox"/>
6. Do you think stem cells are useful?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
7. Do you know that stem cells can be derived and stored for future?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
8. Do you think they can be stored at home?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
9. Do you know that they can be used in transplantation?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
10. Have you heard or read about any cases who were benefited by stem cells?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
11. Did you store your's or your family members stem cells?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
12. Did you know that your stem cells can be useful for your family members?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
13. Do you think pulling out tooth for stem cells when required, is better, rather than storage of stem cells at younger age?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
14. Are you aware of the uses of stem cells in dentistry?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
15. Do you know that stem cells can regenerate pulp?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
16. Are you aware of tooth banks?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
17. Which tooth do you think are best for the storage of stem cells?	A. Incisors C. Premolars	<input type="checkbox"/> B. Canines <input type="checkbox"/> D. Molars	<input type="checkbox"/>
18. Do you think carious tooth can be useful for storage of stem cells?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
19. Do you think dental stem cells can also be used for treating other medical conditions?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
20. Are you aware that therapeutically extracted teeth can be used for storage of stem cells?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
21. Do you think HIV carriers can store their dental stem cells?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
22. How long do you think stem cells can be stored?	A. 15 to 20 yrs C. 20 to 25 yrs	<input type="checkbox"/> B. 25 to 30 yrs <input type="checkbox"/> D. 30 to 35 yrs	<input type="checkbox"/>
23. Do you think stem cells therapy can be dangerous?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
24. Do you think stem cell usage can play a major role in future dentistry?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
25. Do you think stem cells research should be a part of dental curriculum?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>
26. Do you promote dental stem cell storage in your clinic?	Yes	<input type="checkbox"/> No	<input type="checkbox"/>

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