RESEARCH ARTICLE

Knowledge and awareness of dental stem cells among dental healthcare professionals – a cross-sectional study

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Abstract

Objective: To assess knowledge and awareness of dental healthcare professionals on dental stem cells.

Methods: A questionnaire survey-based study was conducted using Google forms on a sample of 69 dental healthcare professionals (DHCP) from September – October 2022, after obtaining ethical approval. A validated questionnaire was used to assess the knowledge and awareness of dental healthcare professionals on stem cells, which was then divided into three sections. The section A was about demographic statistics, section B assessed knowledge and awareness regarding dental stem cells and section C consisted of 5 score VAS scale to assess the acceptability of future research and increase implication of dental stem cells (DSC) among DHCP. The frequency of each question was reported in percentages. To assess the difference of knowledge and awareness of DSC among different specialties of DHCP, one-way ANOVA test was applied and incase of significant results pairwise comparison was performed by post-hoc Tukey test.

Results: Mean scores of knowledge and awareness of DSC among female DHCP were 54.26 ± 11.73 and males were 53.50 ±8.19. There was a statistically significant difference of knowledge (p= 0.02) among different dental healthcare professionals. On pairwise comparison by post-hoc Tukey HSD we found statistically significant difference (p = 0.03) of knowledge and awareness of dental stem cells among general dentists and operative dentistry specialists.

Conclusion: We found poor knowledge and awareness of dental healthcare professionals regarding dental stem cells. However, operative and endodontic specialty had more awareness on dental stem cells as compared to any other specialty. There was positive approach for further future researches on stem cells.

Keywords: Dentistry, Operative, Stem Cells, Demography.

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Introduction

Stem cells are actually those body cells which are capable of self-replication, division and differentiation to at least any one form of cell type throughout their lifetime.[1-2] In this process of self-replication they undergo cycles of cell division from an undifferentiated form to develop into a newer form of cells.[3] As they have the ability to undergo a cycle of cell division without full differentiation, they play a significant role in self-reparative system of the human body.[4,5] Stem cell technology has now been employed to facilitate the development of missing, malformed or dysfunctional parts of the human body.[6,7]

Embryonic stem cells are multi or pluripotent as they have an unlimited capacity for cell division before cell differentiation.[8-10] The major disadvantage of harvesting embryonic stem cells are that during the process of harvestation, development of the embryo can disrupt and there are increased chances of neoplastic changes in embryonic stem cells as compared to somatic stem cells if not carefully monitored.[11-12] On the other hand, their adult counterpart stem cells are totipotent with a limited capacity for division and differentiation, but they are not subjected to ethical concerns.[13] As per available literature experimental harvested adult stem cells can be amniotic fluid, blood of umbilical cord, bone marrow, brain cells, teeth, skin and urine.[14,15]

Stem cells are often however focused to distinguish into particular cell types. This suggests the strong opportunity of a self-renewal source of replacement and tissues to cure and to find the best remedy for conditions such as Alzheimer's disease, Parkinson, arthritis, thalassemia, cholelithiasis, pheochromocytoma and radiation-induced tissue damage.[16] Stem cells combined with anti-aging genes can possibly engage the process of cellular aging.[17] The young stem cells in humans can revive the current cells and let the body age elegantly and reverse some qualities of the aging process. Moreover, stem cells have also shown a possibility to treat blindness even in late stages of disease.[13]

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Dental stem cells (DSC), a significant source of mesenchymal stem cells (MSCs), can be simply attained from the teeth and used for cures of various diseases.[18] DSC resulting from tooth extraction are adult stem cells.[19] DSC can be an exceptional basis of autologous stem cells for pulp tissue restoration, missing PDL rejuvenation and tooth structures generation for biological implants. Clinical trials[16-20] have been steered on alveolar ridge expansion and its self-renewal with dental stem cells, renovation of resected mandible, and generation of similar human shaped temporomandibular joint.

The field of dentistry is not spared from such debates. Literature search suggested that there is a lack of knowledge of facts connected to different surveys and opinion. A practitioner survey of opinions towards regenerative endodontics in USA revealed that 96% of participants believed that such therapies should be merged into dental treatment.[21-22] The sole objective of this study is to investigate awareness, attitude, and knowledge of use of stem cells in Dentistry in Pakistani DHCP.

The null hypothesis of this study is that dental healthcare professionals are well aware of clinical implications and harvestation of dental stem cells.

Methods

After taking ethical approval (2022-7957-22677) a survey-based cross-sectional study was conducted by employing Google forms for the assessment of knowledge and awareness of the uses of dental stem cells among dental healthcare professionals from private and public hospitals and clinics. All practicing dentists were included in the study. Soft copy Google form was sent through Whatsapp groups of Pakistani dentists and hardcopy was distributed to all the eligible general dental practitioners, specialist dental practitioners, and dental students. They were sent a soft reminder five times over a period of one month. The assessment was conducted on the basis of validated questionnaire which was then divided into three sections.[15] The Questionnaire was made available after the participant signed the consent form for participation in the study. Section A was about demographics, section B had 17 questions regarding knowledge and awareness of DSC and its implications and section C was based on 5 scale rating to assess acceptability of future researches and implications of DSC. Reliability calculation for this questionnaire conducted by Abedi et al.[15] using Cronbanch's alpha method, reported Cronbach's alpha index of 0.79 for attitude and 0.51 for knowledge of dental stem cells among dental healthcare professionals.

The sample size was calculated using Open-Epi[23] software using the findings of Jose14 who reported a 93.4 % frequency awareness of dental professionals regarding dental stem cells. Keeping the sample of 500 and after inflation of 10% we found a total sample size of 69 subjects. The link of Google form was sent to university students studying dental surgery, general dentists working in private and public sector and dental postgraduates or specialists through WhatsApp and outlook mail.

Statistical analysis: Data were collected directly from Google forms to Microsoft Excel and SPSS software (Version 20.0, SPSS Inc. Chicago) and then double-checked. The normality of data were analyzed by the Shapiro-Wilk test. Data were normally distributed. Frequencies and percentages for each question on awareness of dental stem cells were reported for categorical variables such as, gender and education.The frequency of each question was reported in percentages. (Table 1) To assess the difference of knowledge and awareness of dental stem cells among different specialties of dental healthcare professionals, one-way ANOVA test was applied and incase of statistically significant result, pairwise comparison was performed by post-hoc Tukey test. The same tests were applied to assess the difference between dental students, residents and consultants. A p-value < 0.05 was considered statistically significant.

Results

The frequencies and percentages of descriptive statistics of dental healthcare professionals and total percentage of knowledge and awareness, implications and research activities on dental stem cell have been summarized in Table I. The sample of DHCP included 42 females and 27 males. Mean scores of knowledge and awareness of DSC among female DHCP were 54.26 ± 11.73 and male DHCP were 53.50 ± 8.19 as shown in Table 2. Comparable mean scores of knowledge and awareness of DSC among undergraduate and post-graduate students were found (52.07 ± 12.99 and 55.36 ± 9.79 respectively). This difference was statistically insignificant with $p= 0.35$ on independent T-test. By analyzing the difference of mean scores among dental specialists, a statistically significant difference with one-way ANOVA test ($p = 0.02$) were found. To assess group-wise comparison post-hoc Tukey HSD was applied and a statistically significant difference ($p = 0.03$) of knowledge and awareness of dental stem cells among dental students and operative dentistry specialists were found. (Table 3)

There was a statistically insignificant difference of knowledge and awareness of DSC among dental

Table-1: Percentage of Correct Answers among Three Groups of Dental Care Professionals

	Knowledge and Awareness Regarding Dental Stem Cells Among Dental Healthcare Professionals Questionnaire	Responses of DHCP		
		Correct	Wrong	Don't Know
Q.1	Stem cells are an unspecialized type of cells which are capable of forming any cell type	97.1%	94.2%	2.9%
Q.2	Human sperms and eggs are considered a source of adult stem cells	58.0%	37.7%	20.3%
Q.3	Stem cells obtained from adults are specialized cells that can form either bone or cartilage only	69.6%	56.6%	13.0%
Q.4	Embryonic stem cells can be obtained from umbilical cord	66.7%	43.5%	23.2%
Q.5	Adult bone marrow stem cells are usually taken from the spine	50.7%	23.2%	27.5%
Q.6	Chondrocytes are considered one type of stem cells	47.8%	21.7%	26.1%
Q.7	Availability of stem cell banks are now available in Pakistan	27.5%	27.6%	55.1%
Q.8	Stem cells obtained from which dental tissues are considered adult stem cells	58.0%	20.3%	21.7
Q.9	Dental stem cells exfoliated from deciduous teeth are considered useful source of stem cells	55.1%	20.3%	24.6%
Q.10	Dental stem cells can be retrieved from apical papilla of the tooth.	59.4%	11.6%	29.0%
Q.11	One potential application of stem cells is to allow root formation following trauma	82.6%	11.6%	5.8%
Q.12	Sound deciduous incisors and canines are better source of dental stem cells than deciduous molars	24.6%	26.1%	49.3%
Q.13	Autologous transplant of adult stem cells can fail mainly because of immunogenic reaction	37.7%	33.3%	29.0%
Q.14	Dental implants derived from stem cells are now available to replace missing teeth	47.8%	31.9%	20.3%
Q.15	Will you recommend treatment with stem cells and their potential application if it is available	82.6%	11.6%	5.8%
Q.16	What is the major side effect of dental stem cells usage	40.6%	24.6%	34.8%
Q.17	The use of dental stem cells in dentistry contradicts ethical and religious principles	21.7%	40.6%	37.7%
	Future Approach for Research on DSC			
Q.18	Adding a special course concerning stem cells to the dental curriculum is advisable	3.97 ± 0.96 (mean ± S.D)		
Q.19	I have attended scientific activities related to stem cells outside curriculum	1.94 ± 1.31 (mean ± S.D)		
Q.20	I am interested in attending advanced training course about stem cells and their applications in dentistry	3.94 ± 1.17 (mean ± S.D)		
Q.21	There should be more public awareness programs about stem cells and their therapeutic applications	3.86 ± 1.16 (mean ± S.D)		
Q.22	I will consider specializing in dental treatment with stem cells if it became a recognized dental specialty in future.	3.81 ± 1.27 (mean ± S.D)		
Q.23	I am aware of stem cell research and potential application of stem cells in dentistry	2.86 ± 1.17 (mean ± S.D)		

DHCP: Dental Healthcare Professionals, DSC: Dental Stem Cells, S.D: Standard Deviation

Table-2: Descriptive statistics

Professions	Gender	Age (years) (means ± SD)	Experience (years) (means ± SD)	Work Place	Knowledge (scores) (means ± SD)
Dental Students	F = 31 (100%)	22.0 ± 2.52	1.8 ± 1.5	PuH = 24 PH = 5 PC = 2	52.25 ± 12.43
Dental Residents	F = 17 (81.0%) M = 4 (19.1%)	32.62 ± 1.74	3.37 ± 1.16	PuH = 4 PH = 17	55.37 ± 8.2
Dental Consultants	F = 12 (75.0%) M = 4 (25%)	32.62 ± 1.74	7.19 ± 3.01	PuH = 2 PH = 11 PC = 3	
Orthodontists	F = 20 (83.3%) M = 4 (16.7%)	35.6 ± 4.8	10 ± 5.2	PuH = 2 PH = 10 PC = 1	54.66 ± 11.26
Operative Dentists	F = 3 (77.8%) M = 2 (22.2%)	30.5 ± 7.0	8.2 ± 5.3	PuH = 2 PH = 3	65.33 ± 5.75
Maxillofacial Surgeon	F = 7 (77.8%) M = 2 (22.2%)	45.8 ± 9.5	23.6 ± 12.5	PH = 7 PC = 2	59.2 ± 3.71
General Dentistry	M = 6 (100%)	47.2 ± 5.9	19.0 ± 1.1	PH = 4 PC = 2	51.02 ± 12.40

N = 69, F = 39, M = 45, SD: Standard Deviation, PuH: Public Hospital, PH: Private Hospital, PC: Private Clinic, F: Females, M: Males

Table-3: Comparison of Scores of Knowledge among Dental Healthcare Professionals

Mean Scores among Three Dental healthcare Professionals (One-way ANOVA)				
Profession	**Orthodontists (n = 24) (means ± SD)**	**Operative dentists (n = 16) (means ± SD)**	**General Dentists (n = 28) (means ± SD)**	***p*-value**
Knowledge scores	54.66 ± 11.26	65.33 ± 5.75	51.02 ± 12.40	0.02*

Pair-wise Comparison among Dental Healthcare Professionals (Post-hoc Tukey)			
	Orthodontists vs. Operative dentists (*p*-value)	**Operative dentists vs. General Dentist (*p*-value)**	**General Dentists vs. Orthodontists (*p*-value)**
Knowledge scores	0.66	0.03*	0.73

N= 84, *p ≤ 0.05, One-way ANOVA, Post-hoc Tukey

students, residents and consultants with scores of 52.25 ± 12.43, 55.71 ± 11.88 and 55.37 ± 8.28 respectively.

Discussion

Dental healthcare professionals included in this study were assessed regarding knowledge, awareness and scope of research for the implications of dental stem cells. In this study there were almost 50.71% correct answers given by DHCP and 49.28% wrong answers. This indicates that knowledge and awareness of DHCP for implications of DSC is still not very strong and clear, which rejects our null hypothesis.

Almost all the dental healthcare professionals knew about basic facts of dental stem cells, that they can be differentiated into any other form of cells, with a correct answer score of 97.10%.[16] However, detailed knowledge like source of stem cells, implication of stem cells after dental trauma, adult stem cells and availability of dental stem cell pool in Pakistan was not very strong. This could be due to the fact that graduation course books contain only the basic information of stem cell i.e., definition but still detailed chapters and research resources on dental stem cells are not easily available.[20] From the findings of section C of questionnaire, it can be concluded that all the students, residents and even the consultants were very willing to initiate workshops and learn more about the implications of dental stem cells. A very positive approach of dental healthcare professionals for the future prospective of extracting and exploring more about these cells. Dental healthcare professionals were even not sure about the fact that extraction of stem cells from the tooth pulp have the least chances of ethical concerns as compared to extraction from any other source.[19] Hence, it is believed that available literature knowledge on stem cells should be included in the course of bachelor in dental surgery.

On comparison between dental students, dental residents and dental consultants, no statistically significant difference was observed in the scores. Contradictory to the findings of the study conducted by Abedi et al.[15], in which the author found significantly increased scores of knowledge and awareness regarding stem cells among dental residents as compared to dental students.[15] They claimed that this could be due to increasing specialized courses in dental hospitals in their region.[15] Their claim was further justified by our pairwise comparison of differences between specialties where a statistically significant increase in scores among operative residents as compared to dental students was found. Their scores were higher than any other dental specialty. This is due to the fact that operative and endodontics is the leading specialty of the field to work on dental trauma and extraction of deciduous teeth.

There are certain ethical and religious concerns in the extraction of stem cells from any other source except dental stem cells.[16-18] Hence we believe that dentists should have more knowledge and awareness on extraction and implications of dental stem cells. To increase these scores not only DHCP but dental institutes and governments should play leading roles. This is the first study in Pakistan to assess knowledge and awareness of DHCP on stem cells.[14] However, the questionnaire included in this study, to assess knowledge, was short, and does not assess every perspective implication of stem cells in a different speciality.[18] Hence this study should be followed up in future with awareness sessions regarding dental stem cells followed by a re-administration of the questionnaire to see the improvement in the participants' knowledge and awareness.

Conclusion

Findings of this study reveal that knowledge and awareness of dental stem cells among DHCP is not very strong and should be improved. However, we found that operative and endodontic specialty had more awareness on dental stem cells as compared to any other specialty. We also found a positive approach of dental healthcare professionals on increasing further knowledge and future research regarding dental stem cells.

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