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## Percepcija znanstvenika i poslijediplomskih studenata o budućnosti matičnih stanica u stomatologiji

### *Perception of Dental Scientists and Post-Graduate Students Regarding Future Prospects of Stem Cells in Dentistry*

Zavod za primarnu dentalnu zaštitu Stomatološkog fakulteta u Jaipuru, Indija  
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#### Sažetak

Korištenje matičnih stanica u stomatologiji sve je češće pa će sljedećih godina biti iznimno važno znanje, ali i vještine kako bi se mogle uporabiti. Zato treba doznati što ljudi misle o toj temi. U Indiji je primjena matičnih stanica u stomatologiji još u povojima i ograničeno je znanje o njihovu korištenju. **Svrha:** Ovo istraživanje provedeno je kako bi se usporedili znanje, osviještenost i stajališta članova stomatološke akademske zajednice o matičnim stanicama u njihovoj struci. **Materiali i metode:** U istraživanju je sudjelovalo 100 stručnjaka (diplome MDS i BDS), uključujući i postdiplomante s triju stomatoloških fakulteta u Jaipuru. Testiranje je obavljeno s pomoću upitnika. **Rezultati:** Pozitivno stajalište o budućoj primjeni matičnih stanica u stomatologiji imalo je 99 posto ispitanika. Njih 67 posto smatra da će uporaba te suvremene tehnologije biti moguća u sljedećih deset godina. Svi sudionici imali su određeno znanje o klasifikaciji matičnih stanica (68 %) i njihovu izvoru (59 %) te o primjeni u stomatologiji (71 %). Hi-kvadrat test pokazao je značajnu povezanost između liječnika dentalne medicine i uporabe matičnih stanica u stomatologiji. No 60 posto njih priznalo je da premalo zna i nema nikakvo iskustvo u uporabi matičnih stanica, što sprječava pacijente da zatraže takav tretman. **Zaključak:** Gotovo svi ispitanici imali su pozitivno stajalište o matičnim stanicama, iako je znanje o njima dosta ograničeno. Količina znanja uglavnom ovisi o kvalifikaciji, a ne o iskustvu. Prije nego je potrebno povećati znanje među profesionalcima o kliničkoj aplikaciji matičnih stanica u stomatologiji.

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#### Ključne riječi

matične stanice; stomatologija; stav zdravstvenih djelatnika; studenti stomatologije

#### Uvod

Matične stanice su nediferencirane stanice s mogućnošću reprodukcije u identične nediferencirane stanice (1). Naziv im je 1908. godine dao ruski histolog Aleksander Maksimov (2). Matične stanice počele su se 1968. godine primjenjivati u liječenju teških imunskih bolesti. (3). Nacionalni institut za zdravstvo (NIH) priopćio je 2000. godine da su matične stanice pronađene u impaktiranim trećim molarima, a njihov otporniji soj u uzorku SHED (Stem cells from Human Exfoliated Deciduous teeth) – u matičnim stanicama otpalih mliječnih zuba. Za to je otkriće zaslužan dr. Shi (2003.) (4).

Matične stanice mogu se podijeliti prema stadiju razvoja, plasticitetu i izvoru (2,5,6). Izvori postnatalnih dentalnih matičnih stanica su trajni i mliječni zubi, parodontni ligament, zubna papila, prekobrojni zubi, ekstrahirani zubi u ortodontske svrhe te stanice dentalnog folikula, pulpe i zubnog folikula (2,4)

Matične stanice iz zubne pulpe (DPSC, eng. Dental Pulp Stem Cells), SHED-a, zubne papile, stanica zubnog folikula i parodontnog ligamenta dostupne su i mogu se pohraniti, pa su jeftina investicija u slučaju liječenja bolesti. Stanice

#### Introduction

Stem cells are undifferentiated cells with the ability to divide and give rise to identical, undifferentiated cells (1). The term stem cells was proposed for scientific use by Russian histologist Alexander Maksimov in 1908, (2). Its application for treatment of severe combined immune deficiency was established in 1968, (3). National Institute of Health (NIH) in 2000 mentioned the discovery of adult stem cells in impacted third molars and more resilient stem cells in deciduous teeth with SHED (Stem cells from Human Exfoliated Deciduous teeth) discovered by Dr. Shi in 2003 (4).

Stem cells have been classified according to growth stage, plasticity and sources (2,5,6). Sources of postnatal dental stem cells include permanent teeth, deciduous teeth, periodontal ligament, stem cells from apical papilla and stem cells from supernumerary tooth, stem cells from teeth extracted for orthodontic purposes, dental follicle progenitor cells, stem cells from human natal dental pulp, and stem cells from dental follicle (2,4).

Dental stem cells including DPSC (Dental Pulp Stem Cells), SHED and stem cells from apical papilla, dental fol-

SHED-a mogu se dobiti iz prirodno ispalih mliječnih zuba i iskoristiti se kao izvor postnatalnog ljudskog tkiva (4, 5, 6).

Čuvanje ekstrahiranih zuba u bankama za zube omogućilo bi liječenje kompliciranih bolesti i ozljeda koje se mogu dogoditi tijekom života. Takve licencirane ustanove u Indiji su Reliance life Science – Delhi, Life cell – Chennai, Stemade Biotech Pvt. Ltd. – Indija i The Norwegian Tooth Bank (4).

Trenutačne stomatološke tehnike za koje su potrebne matične stanice uključuju nastavak formiranja korijena, liječenje pulpe i regeneraciju, replantaciju i transplantaciju, regeneraciju i stvaranje pulpe i dentina, stvaranje korijena te rekonstrukciju parodonta (2,3,5,7–10). Iz dentalnih matičnih stanica mogu se razviti i ostala tkiva, a mogu se iskoristiti za liječenje različitih sistemskih bolesti, dijabetesa, mišićne distrofije, Parkinsonove bolesti, infarkta miokarda, artritis, rekonstrukcije mekog tkiva te bolesti jetara (11).

Problemi u korištenju različiti su i kompleksniji od osnovnog problema, a to je nedostatak znanja o matičnim stanicama. Teškoće se uglavnom odnose na etička i vjerska pitanja, kloniranje ljudi, iskorištavanje embrija i jajnih stanica davatelja te na alternativne načine dobivanja matičnih stanica (6). Istraživanja ograničava i nesigurnost u principu stvaranja novih dentalnih tkiva kako bi morfološki što više sličila prirodnima, nedostatak zamjene za oralni epitel embrija koji bi nadomjestio mezenhimalne stanice u koštanoj srži, odbacivanje tkiva te etičke dileme o uporabi ljudskog zametka (4).

Nakon zabrane istraživanja na matičnim stanicama 1995. godine, pokusi su se uglavnom obavljali u privatnim ustanovama. No unatoč tomu, NIH je 1999. odlučio poduprijeti eksperimente na već otkrivenim sojevima matičnih stanica (2). Indijsko vijeće za medicinska istraživanja (Indian Council of Medical Research – ICMR) odredilo je smjernice za pokuse na matičnim stanicama, no bez jasnih odredbi o istraživanju na dentalnim matičnim stanicama (12, 13).

Ovo istraživanje obavljeno je kako bi se odredili i usporedili znanje i osviještenost stomatološke akademske zajednice, uključujući i postdiplomante, kad je riječ o mogućoj uporabi matičnih stanica u stomatologiji i doznalo koliko stručnjaci znaju o toj temi. Dentalne matične stanice novost su u stomatologiji i mnogo obećavaju. Zasad stomatolozi malo znaju o njihovu potencijalu.

## Materijali i metode

Istraživanje je provedeno u rujnu 2013. godine na temelju upitnika. Sadržavao je 17 provjerenih pitanja zatvorenog tipa i ispitanici su ga sami ispunjavali. Bio je na engleskom jeziku. Istraživanje je odobrilo Etičko povjerenstvo Stomatološkog fakulteta u Jaipuru.

Pitanja su bila sastavljena prema pitanjima iz sličnih istraživanja, člancima o dentalnim matičnim stanicama te inter-netskim izvorima. Nakon rasprave o tome koja pitanja treba uvrstiti neka su iz izvornog upitnika izbačena (15 pitanja),

licular progenitor cells and periodontal ligament cells are accessible, can be stored easily and are cost-effective for future cure of ailments. SHED cells are retrievable from naturally exfoliated teeth as a source of postnatal human tissue (4,5,6).

Tooth banking promises opportunity for treating challenging diseases and injuries which would occur throughout life. The licensed tooth banks in India include Reliance life Sciences, Delhi; Life cell, Chennai; Stemade Biotech Pvt. Ltd. India; The Norwegian Tooth Bank (4).

The current scope of application of stem cells in dentistry includes continuing root formation, pulp healing and regeneration, replantation and transplantation, pulp/dentin tissue engineering and regeneration, bioroot engineering and reconstruction of periodontium (2,3,5,7-10). Other tissues throughout the body can also be developed by the use of dental stem cells, their application in treatment of systemic diseases, diabetes, muscular dystrophy, Parkinson's, cardiac infarction, arthritis, soft tissue reconstruction, liver disease as well as others (11).

Problem with the use of stem cells is diverse and beyond the mere lack of knowledge of stem cells. These include ethical, religious issues, human cloning, exploitation of embryo and egg donors and new alternatives to obtain stem cells (6). Limitations of stem cell research include uncertainty of the principles of tissue engineering related to tooth regeneration to resemble correct tooth morphology; lack of substitute for embryonic oral epithelium to replace mesenchymal cells, adult bone marrow cells; concerns of host immune rejection and ethical issues on the lack of human embryo (4).

Since the ban on embryonic research in 1995, stem cell research has largely been privately funded. In 1999, however, NIH extended support for research on embryonic stem cell lines which had been established (2). Indian Council of Medical Research (ICMR) has given certain guidelines for stem cell research, but not emphasized for research on dental stem cells (12,13).

This study was undertaken with an objective of determining and comparing the knowledge, awareness and attitude of post-graduate students and dental scientists towards the possible application of stem cells in dentistry. Dental stem cell research is a new field in dental health sciences, which seems to hold a vast potential. However, not much is known about it among dental health caregivers. This research was carried out for scoping the span of knowledge that these professionals have in this area.

## Materials and Method

The present study was a questionnaire based survey (cross-sectional study) conducted in September 2013. A 17 item questionnaire was delineated. The questionnaire was pre-tested, close-ended and self-administered. The questionnaire was in English language. The ethical approval was obtained from the Ethical Committee of Jaipur Dental College.

The questions were developed on the basis of other similar studies, some articles related to dental stem cells and other internet sources. After deliberations, some questions of the

neka su promijenjena, a dodana su dva nova. Završna verzija sadržavala je 17 pitanja na koja su odgovori trebali pokazati razinu znanja, osviještenost i stajališta o mogućoj primjeni matičnih stanica u stomatologiji.

Upitnik je zatim iskorišten za eksperimentalnu studiju među članovima akademske zajednice i postdiplomantima u Zavodu za primarnu dentalnu zaštitu Stomatološkog fakulteta u Jaipuru. Dodani su i određeni bodovi, ovisno o tomu koliko je koje pitanje bilo povezano s trenutačnim istraživanjem. Na pitanja je odgovaralo 100 sudionika na trima stomatološkim fakultetima u Jaipuru.

Od 130 podijeljenih upitnika 100 se vratilo ispunjeno za 30 minuta koliko je bilo određeno za ispunjavanje (uzorak od 60 ispitanika dovoljan je za istraživanje na temelju upitnika).

Ispitivači su rezultate odmah unijeli u Microsoft Excel 2010. Analizu su obavili softverom Predictive Analysis (Version 18). Koristili su se i Pearsonovim Hi-kvadrat testom i izračunali postotak uzorka kako bi se analizirao raspon znanja o korištenju matičnih stanica u stomatologiji.

## Rezultati

*Profil ispitanika:* 47 znanstvenika (MDS – 28, BDS – 19) te 53 postdiplomanta s triju stomatoloških fakulteta, podjednako su bili zastupljeni prema spolu, prosjek godina iznosio je 29,5, a 70 posto imalo je pet godina iskustva ili manje.

*Odgovori ispitanika o primijenjenom znanju i osviještenosti o dentalnim matičnim stanicama:* prema odgovorima, za 73 posto ispitanika primarni izvori podataka o matičnim stanicama bili su stručni časopisi i profesionalne udruge, a 15 posto navelo je da su informacije pronalazili na internetu i u novinama (slika 1.).

Ispitanici su bili informirani o matičnim stanicama – 68 posto znalo je za klasifikaciju, a 59 za izvore. Kad je riječ o uporabi matičnih stanica, 68 posto njih odgovorilo je da se ta tehnologija može uporabiti s dentalnim implantatima, a 21 posto nije bilo sigurno je li terapija matičnim stanicama bolja od dentalnih implantata. Da je od dentalnih matičnih stanica moguće uzgojiti razna tkiva, odgovorilo je 46 posto ispitanika, a 33 posto nije bilo sigurno.

Više od dvije trećine sudionika (71 %) znalo je za potencijal matičnih stanica na završetku rasta korijena, cijeljenja pulpe te rasta pulpe/dentina (slika 2.). Više od 50 posto (51 %) nije bilo sigurno u vezi s uporabom dentalnih matičnih stanica u liječenju ostalih bolesti (Hodginov limfom,  $\alpha$ -talasemija major i Fanconijeva anemija).

*Dodatna statistička analiza:* Hi-kvadrat test izračunat je između akademskog stupnja (od nižega prema višem) i godina iskustva (od manjih prema većima), te razlika u znanju među spolovima (od nižih prema višima) za interval od 95 % ( $p < .05$ ). Vrijednosti su u tablici 1.

Postignuti stupanj stručne spreme bio je najvažniji u odnosu između članova stomatološke akademske zajednice (s diplomama MDS i BDS) i postdiplomanta jer su se razliko-

original questionnaire (15 items) were dropped and/or modified and a few questions were added. In the final questionnaire, 17 items were included, based on knowledge perception and application of stem cells in dentistry.

The questionnaire was subjected to a pilot study on the staff and PG students of Dept. of Public Health Dentistry, Jaipur Dental College. The suggested points were incorporated depending on their merits in relation to the mentioned study. The survey was conducted on (purposive sample) 100 academicians and post graduate students of 3 dental colleges in Jaipur.

Out of 130 copies which were circulated among dental academicians (MDS& BDS) and post-graduate students of 3 dental colleges of Jaipur, 100 returned the questionnaire within the specified time of 30 min (A sample of 60 is considered sufficient for a questionnaire based study).

The questionnaire data were entered in Microsoft Excel 2010 on the same day by the investigator. The analysis was done using Predictive Analytics Software (Version 18). The Pearson's Chi-Square Test, and percentages of the total were used for analysis to gain insight into extent of knowledge perception and application of stem cells in dentistry among academicians and postgraduate students.

## Results

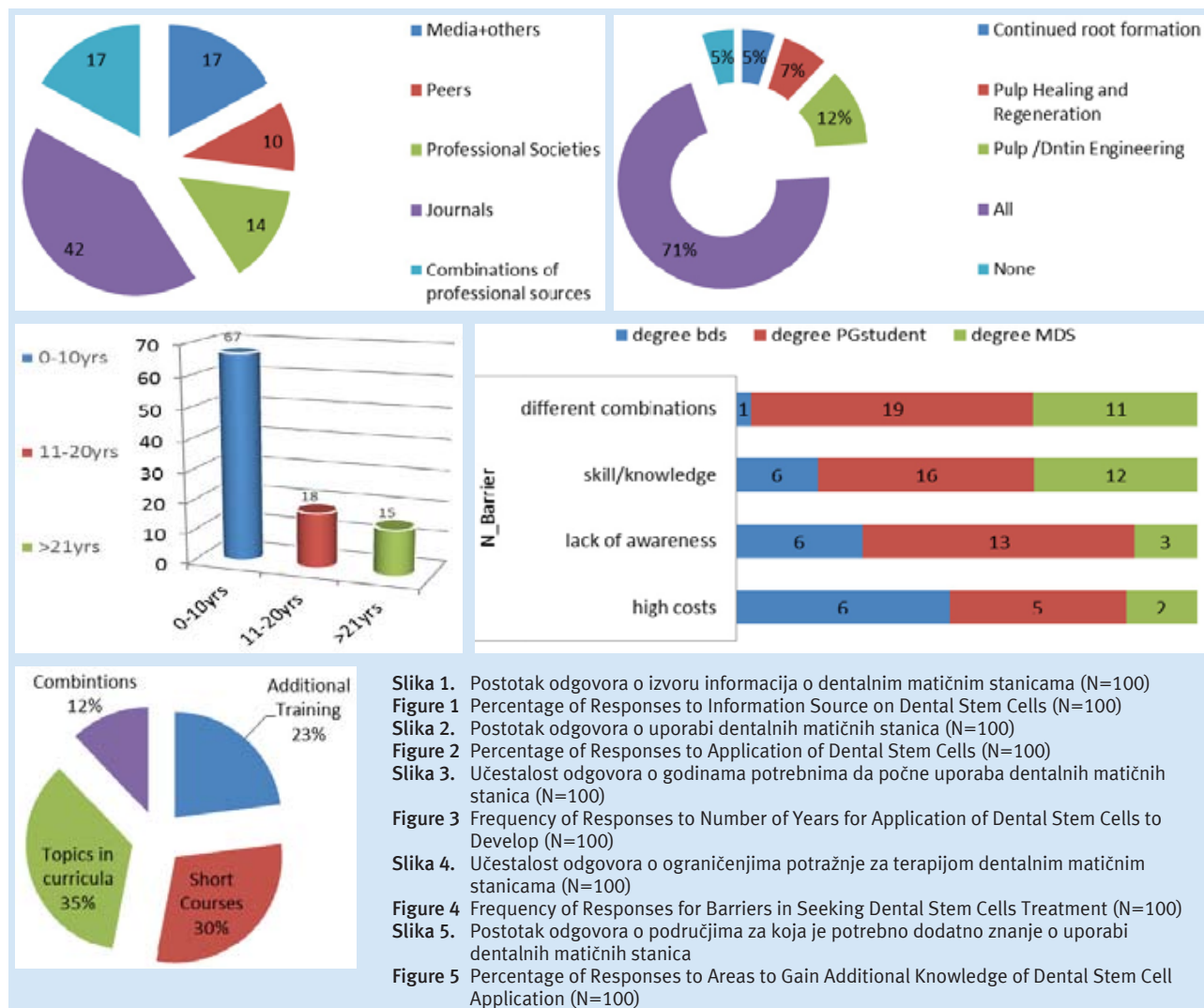
*Profile of respondents:* There were 47 academicians/scientists (MDS-28 and BDS-19), and 53 post-graduate students from 3 dental colleges in the Jaipur, represented by both genders almost equally, with mean age 29.5 years and 70% with 5 years or less of professional experience.

*Respondent's responses to knowledge application and perception dental stem cells:* The primary source of knowledge content was drawn from academic journals and professional societies by respondents (73%), and only a small proportion (15%) gained information from Internet or popular newspapers (Figure 1).

The respondents had *informed* knowledge on stems cells. Unerringly, 68% knew about stem cell classification and 59% about sources of dental stem cells. On possible applications of stem cells in dentistry, 68% stated that the stem cell technology could be effectively used in dental implants and 21% were not sure if dental stem cells therapy was better than dental implants. It was noted by 46% of respondents that dental stem cells could be used to develop non-dental organ, however, another 33% were unsure of this application of dental stem cells.

More than two thirds of the respondents (71%) acknowledged dental stem cells application for continued root formation, pulp healing regeneration and pulp/dentin engineering (Figure 2). More than half (51%) were unsure of the application of dental stem cells in the treatment of other diseases (typically, in Hodgkin's Lymphoma,  $\alpha$ -Thalassemia major and Fanconi's anemia).

*Additional Statistical Analysis:* The Chi-Square test was computed between the Degrees held (ranked from low to high) and years of experience (low to high), gender to extent of knowledge (again scaled from low to high) at 95% confi-



vali u traženju informacija o profesionalnoj izobrazbi, znanju o izvoru dentalnih matičnih stanica, njihovoj uporabi za razvijanje ostalih organa te liječenju ostalih neoralnih bolesti. Tu činjenicu potvrdili su i rezultati Hi-kvadrat testa. Istaknimo da nije bilo značajnih razlika između spolova te u godinama iskustva i znanju ispitanika.

Analizirajući distribuciju znanja i skupljenih informacija prema stupnju visokoškolskog obrazovanja, proporcionalno je više liječnika s diplomom MDS-a (66 %) od onih s diplomom BDS-a (10 %) tražilo informacije o toj temi u stručnim časopisima i profesionalnim udrugama. Skupina s MDS-om točno je odgovorila na više pitanja i pokazala veće povjerenje u tehnologiju matičnih stanica. Prema dobivenim rezultatima postdiplomanti su svrstani između dviju spomenutih skupina.

dence level ( $p < .05$ ). Chi Square test values presented in Table 1.

Qualification emerged as the main determinant (factor) for relation among the dental academicians i.e. MDS and BDS and the post-graduate students in terms of their seeking information about professional knowhow, their knowledge about sources of dental stem cells, application of dental stem cells for the development of non-dental organs, and treatment of diseases other than oral diseases. This is evident from the Chi Square test value. No significant relation was found between gender and years of experience and knowledge of respondents.

Seen in a two-way distribution on information/knowledge by degree held, proportionately many more among those holding MDS-degree (66% compared to 10% holding BDS degree) got their information from academic journals or professional societies. Also, the former group stated the more right answers or expressed confidence in the technology in larger proportions, compared to graduate degree holders, with post-graduate students falling somewhere in between.



**Tablica 1.** Vrijednosti Hi-kvadrat testa i značajnost distribucije dvostrukih varijabli prema kvalifikacijama ispitanika (diplome MDS)  
**Table 1** Chi-Square Test values and their significance for a bivariate distribution of select variables by respondents' qualification (MDS, PG-Student, BDS)

Kvalifikacije • Qualification with...	Vrijednost • Value	Stup. slobode • df	Asymp.sig (2-sided)
Znanje o izvorima matičnih stanica • Knowledge about sources of dental stem cells	9.91	4	0.04
Primjena dentalnih matičnih stanica u razvoju nedentalnih organa • Application of dental stem cells for development of non-dental organs	7.84	2	0.02
Primjena dentalnih matičnih stanica u liječenju Hodgkinovog limfoma, $\alpha$ -Talassemije Major i Fanconijeve anemije • Application of dental stem cells for treatment of Hodgkin's, $\alpha$ -Thalassemia Major and Fanconi's anemia	13.43	4	0.009
Izvori iz kojih se dobiva znanje o matičnim stanicama • Information Sources from where the knowledge of stem cells is drawn	20.96	12	0.05

\*p $\leq$ 0,05

### Percepcija i mišljenje ispitanika o tehnologiji dentalnih matičnih stanica

Gotovo svi ispitanici (99 %) misle da istraživanja matičnih stanica obećavaju i da će se moći primijeniti u stomatologiji. Više od 85 posto sudionika smatra da će to biti moguće za 20 godina (67 % smatra da će se primijeniti u sljedećih 10 godina, a 18 % vjeruje da će se to dogoditi za 20 godina) (slika 3.).

Da se matične stanice mogu pohraniti te da u Indiji postoje banke za njihovo čuvanje, znalo je 46 posto ispitanika. Njih više od 50 posto izjavilo je da je spremno poslati pacijente na terapiju matičnim stanicama, a 68 posto istaknulo je da će tehnologija matičnih stanica *zasjeniti* sadašnje tehnologije u stomatologiji kao što su implantati. Oko 46 posto ispitanika zabrinjavaju etički aspekti korištenja dentalnih matičnih stanica. Za smjernice Nacionalnog odbora za medicinska istraživanja u vezi s istraživanjem na dentalnim matičnim stanicama znalo je 35 posto sudionika. Oko 77 posto njih slaže se s idejom o javno-privatnom udruživanju radi skupljanja i širenja znanja o njihovoj uporabi.

Tablica 2. pokazuje koliko znaju ispitanici o uporabi dentalnih matičnih stanica.

Ispitanici se slažu da će pacijenti biti sumnjičavi prema terapiji s matičnim stanicama jer premalo znaju o toj temi i tehnologiji uopće, ali i zbog cijene (slika 4.). Iste razloge navelo je i 42 posto sudionika istraživanja s MDS-om. Rezultati su u skladu s činjenicom da svi iz stomatološke akademske zajednice, bez obzira na stupanj obrazovanja, teže većem znanju i žele doznati sve dostupno o tehnologiji dentalnih matičnih stanica na tečajevima, predavanjima ili u sklopu

### Respondents' perception and opinions towards dental stem cell technology:

An over-whelming proportion (99%) of the respondents believed that stem-cell research holds a promise for application in dentistry. Again, more than 85% respondents believed that the application of dental stem cells will happen in next 20 years (67% believed that this would happen within the next 10 years, while another 18% believed that this would happen within 20 years) (Figure 3).

The awareness of dental stem cell banking was confirmed by 46% of the respondents who were aware of dental stem cell banks in the country. Over 50% would agree to refer patients for stem cell therapy and 68% asserted that this technology would be superior to the existing practice of dental implants (also noted earlier). Ethical concerns for application of dental stem were raised by 46%. Only 35% affirmed the Indian Council of Medical Research guidelines for dental stem cell research. Public-private partnership to augment resources and spreading the knowledge and application of stem cell in dentistry is preferred by 77% of respondents.

Table 2 presents respondents' responses to awareness of on dental stem cells application.

Both dental academicians and post-graduate students perceive that patients could be hesitant to seek dental stem cell therapy as there is a lack of sufficient knowledge/skill as a determining barrier followed by lack of awareness and to a lesser degree high cost (Figure 4). Of the total MDS respondents, a comprehensive 42% cited this as a reason. These results are complemented by the fact that professionals, irrespective of qualifications (i.e. MDS, PG-student, BDS) as-

**Tablica 2.** Postotak odgovora na ključna pitanja o osviještenosti kad je riječ o uporabi dentalnih matičnih stanica  
**Table 2** Percentage responses to key questions on awareness on dental stem cell application

Pitanje u anketi • Survey Question	Odgovori • Responses		
	Da • Yes	Ne • No	Ne zna • Don't Know
Znanje o bankama matičnih stanica • Awareness of stem cell banks	49%	13%	38%
Etička pitanja o primjeni dentalnih matičnih stanica • Ethical concerns for Dental stem cell application	46%	7%	47%
Znanje o smjernicama ICMR-a za istraživanje dentalnih matičnih stanica • Aware of ICMR guidelines for dental stem cells research	35%	7%	58%
Terapija dentalnim matičnim stanicama bolja je od implantološke terapije • Dental stem cells therapy better than dental implants	68%	11%	21%
Preporuka terapije dentalnim matičnim stanicama pacijentima • Would recommend dental stem cell therapy to patients	52%	10%	38%

predmetne nastave tijekom školovanja (slika 5.). Ali dosad je samo 11 posto ispitanika bilo uključeno u izobrazbu o dentalnim matičnim stanicama. No svi su izjavili da žele steći više znanja o temi.

## Rasprava

Nedavni napredak u prepoznavanju i kategorizaciji dentalnih matičnih stanica te u strategijama modeliranja dentalnih tkiva idu u prilog stajalištu da će se u idućih deset godina moći uspješno regenerirati dentalna tkiva, pa čak i cijeli zub. Kako bi se osigurala primjena istraživanja na kliničkoj razini, mora postojati određeno zanimanje i znanje stručnjaka (13). Ovo istraživanje provedeno je kako bi se dobile informacije o osviještenosti, znanju i trenutačnoj kliničkoj primjeni dentalnih matičnih stanica, tj. koriste li se tom suvremenom tehnologijom članovi akademske zajednice i postdiplomanti s nekoliko stomatoloških fakulteta u Jaipuru. Većina ispitanika bila je razmjerno mlada i na početku profesionalne karijere. Uglavnom svi su bili entuzijasti kad je riječ o stjecanju znanja o matičnim stanicama. To se očituje u njihovu stajalištu da će se rezultati istraživanja o dentalnim matičnim stanicama početi u praksi primjenjivati tijekom sljedeća dva desetljeća. Ti su rezultati u skladu s rezultatima Utneja i kolega iz 2013. godine. Oni su istaknuli da su gotovo svi sudionici u njihovu istraživanju imali podjednaka očekivanja (13). Takvo pozitivno stajalište vjerojatno se temelji na većoj osviještenosti ispitanika zbog čitanja stručne literature, rasprava o toj temi na simpozijima i tijekom stručnog usavršavanja na skupovima o matičnim stanicama te zahvaljujući vijestima u stomatološkim i medicinskim časopisima. Svi ispitanici imali su teoretsko znanje o klasifikaciji i izvorima matičnih stanica te su istaknuli da žele steći konkretnije, praktično znanje. To se može pripisati nedostatku iskustva ili dostatnoj količini znanja o temi, ali i premalom sudjelovanju u istraživanju matičnih stanica. Činjenica je da je istraživanje dentalnih matičnih stanica u Indiji još uvijek u začecima i proći će još mnogo godina dok se rezultati ne budu počeli primjenjivati u kliničkoj praksi. To su potvrdili i ispitanici od kojih većina ističe da se o toj temi premalo zna. Članovi akademske zajednice i studenti izjavili su da će pacijenti na početku nerado prihvaćati tu terapiju upravo zbog premalo znanja i vještina, a zanemarili su cijenu kao ograničavajući čimbenik. Rezultati istraživanja Utneja i suradnika pokazuju, pak, kako je strah od matičnih stanica glavni ograničavajući čimbenik, a cijena je na drugom mjestu. Rezultati dalje upućuju na to da bi terapiju matičnim stanicama trebalo cijenom izjednačiti s ostalim dentalnim zahvatima kako bi se ta terapija popularizirala (13). To se jedino može postići kontinuiranim istraživanjem i razvojem novih, jeftinijih tehnologija.

Ispitanici su pokazali određeni entuzijizam u vezi s predlaganjem terapije s matičnim stanicama jer smatraju da će, kada se tehnologija razvije, biti superiornija negoli današnja primjena dentalnih implantata. Rezultati su u skladu s rezultatima Utneja i suradnika kod kojih je tri četvrtine ispi-

pire to gain more knowledge about dental stem cell therapy, either by attending additional training or short courses or through introduction of knowledge on this subject in the teaching curricula (Figure 5). The strong need is also noted in the fact that only 11% have until so far attended any forum on dental stem cell research, and that all the respondents wish to acquire more knowledge on the subject.

## Discussion

Recent advances in the identification and characterization of dental stem cells, and in dental tissue engineering strategies, suggest that within the next decade, bioengineering approaches may successfully be used to regenerate dental tissues and whole teeth. To ensure that this approach reaches clinical relevance, adequate interest and knowledge backed by research amongst the service providers is the prime requisite (13). This survey was conducted to collect data about the level of awareness, knowledge and present clinical status about stem cell therapies amongst the dental scientists and post graduate students in different dental colleges in Jaipur. Most of the respondents were young and in initial stages of their profession. They expressed enthusiasm about gaining knowledge on this subject. This is reflected in their belief that dental stem cell research will result in effective application within the next two decades. This is concurrent with the findings of the questionnaire study by Utneja S et al. in 2013 which found that almost all participants in their study had similar expectations (13). This positive response could be due to the surge in awareness regarding the topic through sources including scientific journals, discussions on this topic through forums including symposiums, Continued Dental Education Programs and conferences based on stem cell therapies and news dominating dental and medical tribunals. The respondents had theoretical knowledge regarding the classification and sources of stem cells but also expressed desire for more practical experience. This may be due to the lack of adequate skills, or sufficient proven knowledge regarding the subject, as a large majority has not had any formal exposure to dental stem cell research. In addition, stem cell research in dentistry in India is still in its nascent stages and expensive and has a long way before its full-fledged application is reaped in clinical practice. This fact has been highlighted by the participants with majority acknowledging the fact that there is a lack of sufficient knowledge regarding the subject. Academicians and students alike perceived that the patients may be hesitant in seeking dental stem cell therapy owing to lack of sufficient knowledge and/or skills while high cost was not considered by many to be a major deterrent to this effect. The study by Utneja S et al. states that fear of stem cells is the primary fear factor preventing patients to seek dental stem cell treatment, followed by cost. The study goes on to express the need to price the treatment at par with other regular dental treatments so as to popularize the treatment modality (13). This can be achieved by continued research and development of new cost-effective techniques in the field.

The participants were found to be enthusiastic about recommending the patients to consider stem cell therapy and be-

## Upitnik

Broj  
Ime  
Dob  
Spol

Specijalizacija: 1. Oralno-medicinska dijagnostika i radiologija 2. Javno zdravstvo u dentalnoj medicini 3. Protetika 4. Parodontologija 5. Oralna i maksilofacijalna kirurgija 6. Restorativna dentalna medicina i endodoncija 7. Ortodoncija, pedodoncija i preventivna dentalna medicina 8. Oralna patologija

Godine iskustva: 1 godina, 1-5 godina, >5 godina

Godina: 1. 2. 3.

Fakultet i Sveučilište

1. Jeste li ikada susreli termin „matične stanice“?

(1) Da (2) Ne

Ako jeste, (A) koji je Vaš izvor informacija?

(1) Mediji (2) Nastavnici (3) Stručna/profesionalna društva (4) Znanstveni časopisi (5) Drugi (koji)

2. Koje stanice od navedenih spadaju u matične stanice?

(1) Embrijske matične stanice (2) Matične stanice odraslih (3) Oboje (4) Niti jedne

3. Može li se tehnologija matičnih stanica primijeniti u dentalnoj medicini?

(1) Da (2) Ne

4. Koji su izvori matičnih stanica?

(1) Matične stanice pulpe zuba (2) Matične stanice apikalne papile (3) Dentalne progenitorske stanice

(4) Pulpa ljudskog mliječnog zuba (5) Sve navedeno (6) Ne znam

5. Mogu li se dentalne matične stanice koristiti za razvoj nedentalnih organa?

(1) Da (2) Ne

6. Koliko će godina, po Vašem mišljenju, proći prije nego ćemo biti u mogućnosti implantirati ljudima nove zube uzgojene u laboratoriju?

(1) 0-10 godina (2) 11-20 godina (3) >21 godine

7. Ima li u Indiji banaka matičnih stanica?

(1) Da (2) Ne

8. Po Vašem mišljenju, jesu li dentalne matične stanice bolje rješenje od dentalnih implantata?

(1) Da (2) Ne (3) Ne znam

9. Ima li etičkih pitanja u vezi s primjenom matičnih stanica u dentalnoj medicini?

(1) Da (2) Ne (3) Ne znam

10. Koje se bolesti mogu liječiti dentalnim matičnim stanicama?

(1) Hodgkinov limfom (2) Fanconijeva anemija (3)  $\alpha$ -Thalassemia major (4) Sve navedene

(5) Niti jedna od navedenih (6) Ne znam

11. Koji je trenutni cilj primjene dentalnih matičnih stanica?

(1) Nastavak rasta korijena (2) Cijeljenje i regeneracija pulpe (3) Inženjering i cijeljenje pulpe i dentina (4) Sve navedeno

(5) Ništa od navedenog

12. Postoje li smjernice Indijskog vijeća za medicinska istraživanja po pitanju istraživanja dentalnih matičnih stanica?

(1) Da (2) Ne (3) Ne znam

13. U kliničkom radu, biste li pacijentima preporučili čuvanje matičnih stanica i objasnili im buduće izgled?

(1) Da (2) Ne (3) Ne mogu reći

14. Koja je glavna prepreka liječenju dentalnim matičnim stanicama?

(1) Visoka cijena (2) Manjak znanja (3) Manjak adekvatnih sposobnosti (4) Nedostatak dokaza o liječenju na ispitanicima

15. Jeste li ikad sudjelovali u programu/tečaju i/ili trajnoj edukaciji na temu primjene matičnih stanica u dentalnoj medicini?

(1) Da (2) Ne

Ako jeste (A) Biste li bili spremni sudjelovati u naprednom tečaju na temu primjene matičnih stanica u dentalnoj medicini?

(1) Da (2) Ne

Ako niste (B) Biste li bili spremni sudjelovati u tečaju na temu primjene matičnih stanica u dentalnoj medicini?

(1) Da (2) Ne

16. Koja od sljedećih tvrdnji bi mogla pomoći netom završenim dentalnomedicinskim stručnjacima u prikupljanju znanja o matičnim stanicama?

(1) Više edukacije u živo (2) Kratki praktični tečajevi kojima se prikupljaju znanja o matičnim stanicama (3) Teme u vezi s matičnim stanicama u sklopu kurikuluma

17. Po Vašem mišljenju, u kojem bi smjeru trebao ići razvoj istraživanja dentalnih matičnih stanica?

(1) U smjeru inicijativa u sklopu javnog sektora (2) U smjeru inicijativa u sklopu privatnog sektora

(3) U smjeru javno-privatnog partnerstva (4) Drugo

## Questionnaire

S. No: \_\_\_\_

Name: \_\_\_\_\_ Age: \_\_\_\_ Gender: M  F BDS  MDS  PG Student **Specialty:** 1. Oral Medicine Diagnosis and Radiology 2. Public Health Dentistry 3. Prosthodontology 4. Periodontology 5. Oral & Maxillofacial Surgery 6. Conservative & Endodontic Surgery 7. Orthodontology 8. Pedodontics & Preventive Dentistry 9. Oral Pathology**Years of Experience:** 1 year  1-5 years  >5years  **PG Year:** I  II  III **College and University:** \_\_\_\_\_

1. Have you ever come across the term 'stem cells'? (1) Yes (2) No

**IF YES:** 1 (A) What is your source of information?

(1) Media (2) Peer group (3) Professional societies (4) Scholarly journals

(5) Others (Specify)

2. Which of the following could be classified as stem cells?

(1) Embryonic stem cells (2) Adult stem cells (3) Both (1) &amp; (2) (4) None

3. Can stem cells technology be applicable dentistry? (1) Yes (2) No

4. What are the different sources of dental stem cells?

(1) Dental pulp stem cells (2) Stem cell of apical papilla (3) Dental progenitor cells

(4) Dental pulp of human exfoliated deciduous teeth (5) All of these

(6) Don't know

5. Can dental stem cells be used to develop non-dental organs? (1) Yes (2) No (3) Don't know

6. How many years do you think it will take before dentists are able to implant new teeth grown in a laboratory for dental stem cells to develop?

(1) 0-10 year (2) 11-20 years (3) 20 years or More

7. Are there any dental stem cell banks in India? (1) Yes (2) No (3) Don't know

8. In your opinion, can dental stem cells be a better option to dental implants?

(1) Yes (2) No (3) Don't know

9. Are there any ethical concerns regarding use of stem cells in dentistry?

(1) Yes (2) No (3) Don't know

10. Dental stem cells can be used in the treatment of which of the diseases?

(1) Hodgkin's lymphoma (2) Fanconi's anemia (3)  $\alpha$ -thalassemia major

(4) All of these (5) None (6) Don't know

11. What is the current scope of application of dental stem cells?

(1) Continued root formation (2) Pulp healing and regeneration

(3) Pulp/dentin tissue engineering and regeneration (4) All the above (5) None

12. Has Indian Council of Medical Research provided guidelines regarding Dental Stem Cell Research?

(1) Yes (2) No (3) Don't know

13. In a clinical practice, will you recommend patient to store dental stem cells and explain its future prospects?

(1) Yes (2) No (3) Can't say

14. What is the main barrier in seeking dental stem cells treatment?

(1) High cost (2) Lack of awareness (3) Lack of adequate skill

(4) Lack of sufficient proven knowledge about subjects

15. Have you attended a training course/program and/or Continuing Dental Education Program regarding dental application of stem cells?

(1) Yes (2) No

**IF YES:** 15. (A) Would you be willing to attend more advanced training course regarding dental application of stem cells?

(1) Yes (2) No

**IF NO:** 15. (B) Would you be willing to attend Continuing Dental Education Program regarding dental application of stem cells?

(1) Yes (2) No

16. Which of the following statements would most help newly qualified Dental Professionals to be better able to gain knowledge about stem cells?

(1) More real life training (2) Short courses to improve knowledge about stem cells in practice (3) Topics related to stem cells to be included in the curriculum.

17. In your opinion how should dental stem cells research be developed in future?

(1) Under Public Sector initiatives (2) Under Private Sector initiatives

(3) Under Public-Private Partnership (4) Other



tanika izjavilo da bi prihvatili terapiju s matičnim stanicama umjesto implantata (13). Kad je riječ o trenutačnoj primjeni dentalnih matičnih stanica, primjenjuju se kod završetka rasta korijena, cijeljenja i regeneracije pulpe, kod replantacije i transplantacije, razvoja pulpe, dentina i korijena te rekonstrukcije parodonta (2,3). Naši rezultati pokazali su da 75 posto ispitanika zna te činjenice. No 50 posto njih nije bilo sigurno u odgovore o primjeni dentalnih matičnih stanica u slučaju liječenja ostalih sistemskih bolesti kao što su Hodginov limfom,  $\alpha$ -talasemija major i Fanconijeva anemija. Razlog je vjerojatno u tome što se šira uporaba dentalnih matičnih stanica još istražuje pa nema konkretnih dokaza o njihovoj korištenju u terapiji nestomatoloških bolesti (11). Za banke dentalnih matičnih stanica u Indiji znalo je 50 posto ispitanika. Oni shvaćaju i moguće etičke probleme. Većina je čula za ICMR-ove smjernice za istraživanja na matičnim stanicama u Indiji. Istaknimo da su revidirane 2012. godine. Dodajmo da nikoga nisu previše zanimali etički problemi povezani s istraživanjima na dentalnim matičnim stanicama, što ne znači da moralne dileme ne postoje (12, 13).

Svi ispitanici žele se upisati na tečajeve ili slušati predavanja o matičnim stanicama, bez obzira na to jesu li ih već pohađali, a većina nije bila ni na jednom tečaju o primjeni matičnih stanica u stomatologiji. Razlog je u činjenici da se primjena matičnih stanica u stomatologiji još razvija i još se ne zna njihova potpuna primjena. Osim toga nema mnogo tečajeva o praktičnoj primjeni matičnih stanica u stomatologiji, iako je u svijetu tiskano mnogo informacija o napretku u istraživanjima. Ti rezultati u skladu su s rezultatima istraživanja Utneja i suradnika koji su pokazali da je većina ispitanika zainteresirana za izobrazbu o primjeni regenerativnih metoda u stomatologiji (13).

Sudionici i sudionice u istraživanju pokazali su podjednako znanje o dentalnim matičnim stanicama. Rezultat nije u skladu s istraživanjem Sede i suradnika u kojemu se ističe da žene imaju pozitivnije stajalište o matičnim stanicama negoli muškarci, ali prosječno manje znaju o toj temi. To se može zahvaliti kulturnim aspektima još uvijek patrijarhalnog društva u kojemu muškarci češće odabiru stomatološku profesiju (6). U našem su ispitivanju rezultati među spolovima podjednaki zato što se društvene norme mijenjaju i Indije također teže boljem školovanju i poslu. Godine iskustva također nisu bile važne za količinu znanja o temi jer je većina ispitanika imala manje iskustva s više-manje istim obrazovnim temeljima. Akademsko okruženje također nije isključivalo pojedince jer su svi ispitanici imali podjednak pristup edukaciji stavljajući sve ispitanike na istu razinu znanja i razumijevanja teme. Kvalifikacije ispitanika pokazale su se odlučujuće u razini znanja o tematici. Naime, oni s višim kvalifikacijama lakše dolaze do važnih informacija i šira im je baza znanja o relevantnoj tematici.

lied that they are a better option than currently widely used dental implants once the application is well proved. This is in concurrence with Utneja et al. survey which states that three fourths of the participants believe that stem cells are a better option to dental implants (13). Regarding the current scope of application of stem cells in dentistry, they are used in continued root formation, pulp healing and regeneration, replantation and transplantation, pulp/dentin tissue engineering and bioroot engineering and reconstruction of the periodontium (2,3). In the present study, two thirds of the participants knew this fact. On the point of application of dental stem cells in the treatment of systemic diseases including Hodgkin's lymphoma,  $\alpha$ -thalassemia major and Fanconi's anemia, half of the participants were not sure of the answer. This may be credited to the fact that wider application of dental stem cells is still being researched and there is no concrete evidence regarding its use in fields outside dentistry (11). Nearly half of the respondents were aware of the presence of dental stem cell banks in India, and recognized the ethical concerns of application of dental stem cells. More than half of the participants were unaware about guidelines proposed by ICMR regarding stem cells research in India. The ICMR has provided guidelines regarding dental stem cell research in India and these have been revised in 2012. There is however, not much emphasis on the ethical aspects in regard to dental stem cell research. This, nevertheless, does not dilute the fact that there are ethical concerns in use of stem cells (12,13).

Almost all the respondents were willing to attend courses/programs related to stem cells, irrespective of the fact whether or not they had attended one in the past as almost all respondents had not attended a programs/courses related to stem cell or its application in dentistry. This may be attributed to the fact that stem cells in dentistry is still developing and yet to demonstrate its full range of applications. There are not very many practical courses/programs occurring in the field. This is despite the fact that a lot of information regarding its development and advances in the field are being published in scientific and specialty journals globally. This result is consistent with those of the study by Utneja S et al. which noted that the majority of the study participants were willing to attend training courses and/or continuing education courses to apply regenerative dental treatment (13).

Both males and females were noted to have comparable knowledge regarding dental stem cells. This finding is inconsistent with that of the study by Sede MA et al. which noted that although women had a more positive attitude towards stem cells than males, their knowledge was found to be lesser. They attributed this to the cultural aspects as a male dominated society and more males aspiring in the field of dentistry (6). In the current study, the results are similar in either gender owing to the changing cultural patterns in India and women becoming progressively professional. The years of professional experience too had no relation to knowledge or perception about dental stem technology, probably, as majority had a fewer years of academic experience with more or less matching knowledge base. The academic environment also gave them equal access to professional knowledge placing all on equal platform of professional knowledge and

## Zaključak

Svi ispitanici bili su optimisti kad je riječ o budućoj primjeni matičnih stanica u stomatologiji. Izrazili želju za profesionalnim usmjeravanjem i stručnim tečajevima o dentalnim matičnim stanicama. Potrebno je više ovakvih istraživanja kako bismo bolje razumjeli opseg osviještenosti i znanja/vještina među članovima stomatološke akademske zajednice u zemlji kako bi se mogli o toj temi organizirati tečajevi, posebice za one koji u budućnosti žele investirati u razvoj tkivnog inženjerstva.

understanding. The qualification of the participant was the determining factor regarding the knowledge of dental stem cells. This may be attributed to the fact that their knowledge base and exposure increases with higher qualifications.

## Conclusion

All the participants were noted to be optimistic regarding the future prospect of stem cells application in the field of dentistry in the near future. An impending need was felt amongst participants for professional training and additional academic courses on dental stem technology. More survey research on this topic will help in understanding the extent of awareness, knowledge/skill among dental academicians/professionals in the country, for developing additional professional courses on the topic, especially for those aspiring to endorse the (dental) tissue engineering in the future.

### Abstract

**Background:** The advances in application of dental stem cells seem unparalleled in coming years, for which specialized skills and knowledge are of prime importance. Also, there is a need to understand the knowledge, perception and awareness regarding this topic. In India, application of stem cells in dentistry is at a nascent stage and there is limited awareness and knowledge regarding their application. **Objective:** This study was undertaken with an aim to compare the knowledge, awareness and attitude of post-graduate students and dental scientists towards the use of stem cells in dentistry. **Methods:** Questionnaire-based study of 100 dental professionals (MDS and BDS) and post-graduate students from 3 dental colleges in Jaipur. **Results:** Ninety nine percent of the respondents were positive regarding the future of stem-cell application in dentistry. Sixty seven percent see it achieved within 10 years. Respondents had knowledge of classification of stem-cells (68%), sources of dental stem cells (59%) and applications in dentistry (71%). Chi-Square tests showed significant association between academic-levels and application of dental stem-cells. 60% of professionals recognized insufficient knowledge/skill as barriers inhibiting patients from seeking dental stem cell therapy. **Conclusion:** There is a positive attitude towards dental stem cells, although the knowledge about this method is limited. The knowledge is based on the qualification and not the experience. There is a need to increase knowledge among professionals regarding clinical application of the same.

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### Key words

Stem cells; Dentistry; Attitude of Health Personnel; Students, Dental

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