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Virtual reality among dental patients – cross-sectional, questionnaire, pilot study

Wirtualna rzeczywistość a pacjenci stomatologiczni – przekrojowe, ankietowe badanie pilotażowe

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ABSTRACT

INTRODUCTION: Anxiety preceding dental appointment is a common problem among both children and adult patients. It is frequently the reason of avoiding visits what often results in poor oral health and deterioration of general well-being. There is a number of methods regarding patients' relaxation as well prior the appointment as amid one, virtual reality among them.
MATERIAL AND METHODS: The study was carried out among 100 adult dental patients while they waited for their appointment in the waiting room. Interviewees completed the multiple-choice, uncompelled questionnaire containing four questions.
RESULTS: The results show that the most frequently chosen answer was projection of landscapes (40%) or an interactive journey like beach walk or mountain trekking (35%). No differences were observed between men and woman, in both groups projection of landscapes was the most common answer. The vast majority of interviewees (87%) was willing to try virtual reality during dental treatment while the remaining 13% did not want to experience virtual reality at all.
CONCLUSIONS: Most of the participants were eager to try virtual reality amid dental appointment and they rather chose calm and relaxing contend instead of interactive quizzes or games. It is promising that dental patients are willing to be ready to try out innovative technologies in the fight against dental anxiety.

KEYWORDS

dental anxiety, dental treatment, virtual reality, relaxation, dental fear

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STRESZCZENIE

WSTĘP: Strach przed wizytą stomatologiczną jest poważnym problemem zarówno u dzieci, jak i u pacjentów dorosłych. Często staje się on przyczyną unikania wizyt, co może skutkować pogorszeniem nie tylko zdrowia jamy ustnej, lecz także całego organizmu. Istnieje wiele metod mających na celu zrelaksowanie i uspokojenie pacjenta przed samą wizytą oraz w jej trakcie. Wykorzystanie wirtualnej rzeczywistości stanowi jedną z nich.
MATERIAŁ I METODY: Badanie pilotażowe przeprowadzono w grupie 100 dorosłych pacjentów, podczas gdy oczekiwali na wizytę stomatologiczną w poczekalni. Ankietowani wypełniali dobrowolny kwestionariusz wielokrotnego wyboru składający się z czterech pytań.
WYNIKI: Wyniki pokazują, że najczęściej wybieranymi odpowiedziami były projekcja krajobrazów (40%) oraz interaktywny spacer, np. po plaży, lub trekking w górach (35%). Nie zaobserwowano różnic w zależności od płci. Zarówno mężczyźni, jak i kobiety najczęściej wybierali projekcję krajobrazów. Zdecydowana większość ankietowanych (87%) była skłonna skorzystać z dystrakcji z wykorzystaniem wirtualnej rzeczywistości podczas wizyty stomatologicznej. Pozostałe 13% pacjentów nie chciało w ogóle korzystać z wirtualnej rzeczywistości, niezależnie od proponowanego materiału audiowizualnego.
WNIOSKI: Większość pacjentów była optymistycznie nastawiona do skorzystania z wirtualnej rzeczywistości podczas wizyty stomatologicznej. Najczęściej wybierane odpowiedzi były związane ze spokojnymi oraz relaksującymi materiałami niż z grami czy quizami. Badanie wskazuje, że pacjenci stomatologiczni są skłonni korzystać z nowoczesnych technologii w walce z dentofobią.

SŁOWA KLUCZOWE

dentofobia, leczenie stomatologiczne, wirtualna rzeczywistość, relaksacja, strach stomatologiczny

INTRODUCTION

Visiting a dentist is often associated with significant stress level as well as sever fear [1,2,3]. Anxiety preceding dental appointment is a common problem among both children and adult patients. It is frequently the reason of avoiding visits what often results in poor oral health and deterioration of general well-being [4]. Consequences of untreated caries could become a threat not only for oral cavity but also endanger cardiovascular or immune system [5,6,7,8]. Further, orthodontic and prosthetic clinical evaluations with manual or digital prediction are a matter of interest for patients that are commonly related to anxiety [9]. Dental practitioners have been fighting dental anxiety for years with the resources accessible in corresponding times. There is a number of methods regarding patients' relaxation as well prior the appointment as amid one. Some of the methods like music therapy are very effective and commonly used [10,11]. It is scientifically proven that listening to music during stressful events like dental appointment helps to relax and feel less stressed [12,13]. Not only music could be calming to patients nowadays. In the times of rapid development of computer simulations and virtual reality (VR), audio-visual content embedded in VR could be even more successful while providing distraction and combating dental anxiety [14,15,16]. VR is a simulation created by a computer, where the user is able to move around and interact with virtual environment, objects and people. VR establishes safe, standardized, stable environment, which can be adjusted to operator's needs [17]. There are some different methods to implement a user into virtual reality. However, goggles are the most common nowadays. There is built-in screen or a spot to place a mobile phone in order to transfer operator into digitally created word [18]. The aim of the study was to assess the readiness and preferences of patients in term of visual content embedded in virtual reality that can be performed during dental treatment and to analyze the choices of respondents depending on gender, age or frequency of dental visits. There was a main purpose to establish patients' willingness to experience VR during dental procedures as well as precheck the most popular thematic choices in reference to virtual content.

MATERIAL AND METHODS

The study was anonymous and uncompelled (voluntary). To participate in the study 283 randomly chosen dental patients were invited. However, only 100 agreed to fulfill questionnaire. The study was carried out while patients waited for their appointment in the waiting room of a dental clinic. There were 65 females and 35 males in the questioned group. The average age was 40.6 years (± 11.17 SD). There were three different dental clinics chosen to provide more diversity: NL Clinic in Katowice, Nova-Dent in Katowice and Private Dental Practice in Lubliniec. Katowice is a big city, capital of the Silesia region with a population of approximately 300,000 people, while Lubliniec is a small provincial town, with a population over 24,000. Prior to the study an opinion of Committee of Bioethics of Medical University of Silesia was received (PCN/CBN/0052/KB/43/22, 23.03.2022). Prepared questionnaire consisted of four questions. First three questions gathered the general characteristics of respondents: gender (male, female), age (divided into four groups: 18–25 years old, 26–40 years old, 41––55 years old, over 56 years old) and frequency of dental visits (four answers: occasionally, once a year,

twice a year, and more than twice a year). While the remaining one was the actual question considering VR content. The final asked question concerned what, if at all, dental patients would like to see in VR during treatment. The last question was multiple-choice and presented options were following: projection of landscapes e.g. footage of Grand Cannon or National Park filmed by drone; natural documentary e.g. tropical forests or live on grassland; interactive quiz e.g. do a puzzle, solve a labyrinth; word's fun facts e.g. science, sport, art; funny short movies e.g. animals doing crazy things; moving pictures e.g. underwater footage of coral reef; interactive journey e.g. beach walk, mountain hike; cartoon, and finally no use VR at all. Listed propositions of visual content were chosen from different scientific papers considering VR as well as authors' ideas. Eight most frequently occurring answers were placed in questionnaire [19,20,21,22,23]. The questionnaire was handed prior to the dental visit only to the respondents who agreed to participate in the study. An average amount of time to fill in the survey was about five minutes. All the answers were collected and data base was created using Microsoft Excel. Results were presented as percentage distribution of answers as well as statistical analysis. The results were counted using Microsoft Excel and statistical analysis was performed using Statistica (Statsoft Inc. Poland).

RESULTS

The results in general showed that vast majority 87% of respondents would like to experienced VR while sitting on dental chair. Only 13% answered that they would prefer not to use VR at all. The answers with the highest percentage of selections were projection of landscapes (40%) and interactive journey (35%). Meanwhile, the lowest rate of choices was noted in the group of short funny movies (9%) and interactive quiz (11%). To perform statistical analysis VR materials were divided into three groups: contact with nature (landscapes' projection (1), natural documentary (2), moving pictures (5), interactive journey (5)), movies or shorts (natural documentary (2), world's fun facts (4), short funny movies (5), cartoon (8)), interactive video/game (interactive quiz (3), interactive journey (7)). People who have chosen not to use VR during dental visit (13 respondents) were excluded from the statistical analysis. That is why the statistical sample was 87. Further, the sample was divided into two subgroups: respondents who have chosen minimum one VR material from the isolated group versus respondents who have chosen none of indicated answers. In each case chi-square test was performed. The sample of a size 87 is sufficient to execute chi-square test from theoretical point of view.
Unfortunately, in every instance there were no significant correlation between the secluded group and analysed feature (gender, age, frequency of dental visits). In every case p-value is higher than significance level – 0.05.

Results according to age groups

Age is an important factor when it comes to readiness and willingness to experience VR during dental treatment. All the collected data regarding age dependency are presented in Table I. According to percentage discrepancy first age group, respondents between 18 and 25 years old, were the most eager to experience VR (93%). Whereas the highest percentage of interviewees who were not willing to try VR was accumulated in last age group: respondents over 56 years old. However, interviewees' choices about VR content were rather similar regardless of an age group. Most frequently visual content related with nature has been chosen (natural documentary or landscapes' projection). When chi-square test is considered for the collected data, regardless of how the respondents' answers were divided, there were no significant correlation rendering age groups. The results of statistical analysis were presented in Table II, Table III and Table IV.

Table I. Percentage distribution of answers according to age groups

Forms of VR distraction	Age groups			
	18–25 N = 14 (14%)	26–40 N = 32 (32%)	41–55 N = 40 (40%)	> 56 N = 14 (14%)
1	2	3	4	5
Landscapes' projection (1)	43% N = 6	44% N = 14	43% N = 17	21% N = 3
Natural documentary (2)	50% N = 7	16% N = 5	35% N = 14	36% N = 5
Interactive quiz (3)	14% N = 2	13% N = 4	10% N = 4	7% N = 1
World's fun facts (4)	21% N = 3	28% N = 9	25% N = 10	14% N = 2

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1	2	3	4	5
Short funny movies (5)	21% N = 3	9% N = 3	5% N = 2	7% N = 1
Moving pictures (6)	29% N = 4	19% N = 6	20% N = 8	14% N = 2
Interactive journey (7)	43% N = 6	41% N = 13	33% N = 13	21% N = 3
Cartoon (8)	43% N = 6	9% N = 3	10% N = 4	0% N = 0
No VR at all	7% N = 1	16% N = 5	8% N = 3	29% N = 4

VR – virtual reality.

Table II. Chi-square test for age groups according to virtual reality material selected as contact with nature

Data	Age groups					Test	p-value
	18–25	26–40	41–55	> 56	total		
One of answers: 1, 2, 6, 7	11	20	32	8	71	chi-square	0.6318
Other answer	2	7	5	2	16		
Total	13	27	37	10	87		

Table III. Chi-square test for age groups according to virtual reality material selected as movies or shorts

Data	Age groups					Test	p-value
	18–25	26–40	41–55	> 56	total		
One of answers: 2, 4, 5, 8	9	17	22	7	55	chi-square	0.89058
Other answer	4	10	15	3	32		
Total	13	27	37	10	87		

Table IV. Chi-square test for age groups according to virtual reality material selected as interactive video/game

Data	Age groups					Test	p-value
	18–25	26–40	41–55	> 56	total		
One of answers: 3, 7	8	17	16	4	45	chi-square	0.32291
Other answer	5	10	21	6	42		
Total	13	27	37	10	87		

Results according to gender

The differences between males' and females' answers are presented in Table V. The percentage of selected answers were similar in both groups. However, males were more eager to experience VR 97%, compared to only 82% of females. Regardless the gender projection of landscapes has been selected the most often. Statistical analysis using chi-square test revealed no significant correlation between gender and VR materials divided into three groups (contact with nature (1, 2, 6, 7,), movies or shorts (2, 4, 5, 8), interactive video/game (3, 7)). In all analyzed groups p-value was higher than significance level – 0.05, results are presented in Table VI, Table VII and Table VIII.

Table V. Percentage distribution of answers according to gender and general percentage of answers' discrepancy

Forms of VR distraction	Gender		
	female (%) N = 65 (65%)	male (%) N = 35 (35%)	general (%) N = 100 (100%)
Landscapes' projection (1)	40% N = 26	40% N = 14	40% N = 40
Natural documentary (2)	28% N = 18	37% N = 13	31% N = 31
Interactive quiz (3)	12% N = 8	9% N = 3	11% N = 11
World's fun facts (4)	25% N = 16	23% N = 8	24% N = 24
Short funny movies (5)	9% N = 6	9% N = 3	9% N = 9
Moving pictures (6)	17% N = 11	26% N = 9	20% N = 20
Interactive journey (7)	35% N = 23	34% N = 12	35% N = 35
Cartoon (8)	9% N = 6	20% N = 7	13% N = 13
No VR at all	18% N = 12	3% N = 1	13% N = 13

VR – virtual reality.

Table VI. Chi-square test for gender according to virtual reality material selected as contact with nature

Data	Gender			Test	p-value
	female	male	total		
One of answers: 1, 2, 6, 7	45	26	71	chi-square	0.32173
Other answer	8	8	16		
Total	53	34	87		

Table VII. Chi-square test for gender according to virtual reality material selected as movies or shorts

Data	Gender			Test	p-value
	female	male	total		
One of answers: 2, 4, 5, 8	32	23	55	chi-square	0.49264
Other answer	21	11	32		
Total	53	34	87		

Table VIII. Chi-square test for gender according to virtual reality material selected as interactive video/game

Data	Gender			Test	p-value
	female	male	total		
One of answers: 3, 7	30	15	45	chi-square	0.25546
Other answer	23	19	42		
Total	53	34	87		

Results according to frequency of dental visits

Collected data sorted out according to frequency of dental visits are presented in Table IX. In all groups landscapes projection was a preferred choice (ranged between 37% and 43%) followed by interactive journey and natural documentary. In the two marginal groups (occasionally and more than twice a year) were the highest percentage of respondents who would prefer not to use VR at all while treatment is performed (13% and 17% respectively). Results of statistical analysis for three groups (contact with nature (1, 2, 6, 7,), movies or shorts (2, 4, 5, 8), interactive video/game (3, 7)) according to frequency of dental visits are presented in Table X, Table XI and Table XII. However, the calculations were not satisfactory in this subgroup as well. In all analysed subgroups p-value was higher than significance level – 0.05

Table IX. Percentage distribution of answers according to frequency of dental visits

Forms of VR distraction	Frequency of dental visits			
	occasionally N = 31 (31%)	once a year N = 20 (20%)	twice a year N = 14 (14%)	more than twice a year N = 35 (35%)
Landscapes' projection (1)	42% N = 13	40% N = 8	43% N = 6	37% N = 13
Natural documentary (2)	32% N = 10	30% N = 6	29% N = 4	31% N = 11
Interactive quiz (3)	16% N = 5	5% N = 1	7% N = 1	11% N = 4
World's fun facts (4)	29% N = 9	25% N = 5	29% N = 4	17% N = 6
Short funny movies (5)	6% N = 2	10% N = 2	0% N = 0	14% N = 5
Moving pictures (6)	26% N = 8	20% N = 4	21% N = 3	14% N = 5
Interactive journey (7)	39% N = 12	35% N = 7	43% N = 6	29% N = 10
Cartoon (8)	3% N = 1	15% N = 3	14% N = 2	20% N = 7
No VR at all	13% N = 4	10% N = 2	7% N = 1	17% N = 6

VR – virtual reality.

Table X. Chi-square test for frequency of dental visits according to virtual reality material selected as contact with nature

Data	Frequency of dental visits					Test	p-value
	occasionally	once a year	twice a year	more than twice a year	total		
One of answers: 1, 2, 6, 7	22	16	11	22	71	chi-square	0.71674
Other answer	5	2	2	7	16		
Total	27	18	13	29	87		

Table XI. Chi-square test for frequency of dental visits according to virtual reality material selected as movies or shorts

Data	Frequency of dental visits					Test	p-value
	occasionally	once a year	twice a year	more than twice a year	total		
One of answers: 2, 4, 5, 8	17	10	8	20	55	chi-square	0.82953
Other answer	10	8	5	9	32		
Total	27	18	13	29	87		

Table XII. Chi-square test for frequency of dental visits according to virtual reality material selected as interactive video/game

Data	Frequency of dental visits					Test	p-value
	occasionally	once a year	twice a year	more than twice a year	total		
One of answers: 3, 7	16	8	7	14	45	chi-square	0.76322
Other answer	11	10	6	15	42		
Total	27	18	13	29	87		

DISCUSSION

Own research pilot study was conducted to test dental patients' willingness and readiness to experience VR during dental treatment. The fact that only 100 out of 283 invited patients fulfilled the survey may bespeak about the stress which patients experience while waiting for required treatment. That will justify the lack of interest in uncompelled survey. Due to that stress dental patients prefer not to disperse with other activities like presented questionnaire. The majority of respondents were females (65%). It was because females were more willing to fill in the survey. It is a common phenomenon in scientific papers that women are more eager to fill in questionnaires [24,25,26]. Lots of previous researches define dental treatment as stressful and unpleasant what can often lead to dental anxiety [2,3,27]. Suffering from dental anxiety is a common reason of skipping visits which lead to deterioration of oral health [4]. New technologies like virtual reality gives dental practitioners an instrument to fight those fears. The results of own research show that dental patients are disposed and eager to experience virtual reality as a distraction amid treatment. The vast majority 87% answered that they would like to try this form of distraction. Despite dividing the study to partial analysis (age, gender, frequency of dental visits) a general pattern could be observed. Adult patients are more likely to choose calming visual content like natural documentary, landscapes or walks. That were the answers with the highest percentage of respondents' choices. Even though percentage discrepancy shows promising results, those results were not confirmed by statistical analysis. In all of the performed chi-square tests there were no significant correlation between the isolated subgroups and analyzed features (age, gender, frequency of dental visits). Presented tables show that all the p-values were higher than significance level – 0.05.

It is scientifically proven that watching natural environment is considered calming and relaxing [28]. Walsh [28] believes that contact with nature can heal and calm. Closer insight to the performed study allowed to see some tendencies in isolated groups. Differences between age groups were quite predictable, authors' previous assumptions were confirmed. Young people, from the first age group, were the most willing to use VR, while respondents over 56 years old were the least. When it comes to gender the discrepancy between male and female was not so visible. Men were more open to try VR distraction, almost all respondents (97%) express interest in presented stress-relieving technique. However, the tendency to choose natural--related visual content remain despite the gender. The final section of the study was created to analyze the differences when it comes to frequency of dental visits. The incidence of dental visits does not affect respondents' selection of VR distraction content. The highest percentage of patients not willing to experience VR were in the extreme groups though. Both occasionally and more than twice a year group collected the most negative answers about readiness in trying VR distraction, 13% and 17% respectively. According to literature the most commonly chosen forms of distraction during dental procedures performed among children and adolescence were interactive games [29], 3D videos [30] and cartoons [31,32,33]. Adult patients tend to have diverse preferences. Popular choices for children were in the minority while adult respondents decided. The assessment above is based on the percentage discrepancy of collected answers whereas statistical analysis has not provided any data for further conclusions.

Although promising, current pilot study has several limitations. The most important is small sample size. The research was performed only in Silesia region so there was no insight to the larger population preferences. Moreover, the questions in questionnaire were not so precise and accurate. What make it impossible to describe the sample thoroughly. As well the number of listed options was limited. It all was a deliberate sacrifice which make the survey quick and easy to fulfill for all patients in dental waiting room, no matter whether they waited for checkup or in pain. Furthermore, there should be single choice questionnaire or differently created subgroups to achieve more promising results in statistical analysis. Future research is needed to involve both larger sample size and more elaborated and precise questionnaire.

CONCLUSIONS

In conclusion, respondents in this pilot study were willing to try VR as a form of distraction during dental treatment. They were more eager to choose natural related visual content. Virtual reality tends to be the future of relaxation technics in dentistry which can bring great outcomes when further analyzed. The results are promising but there is a need for further research.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Author's contribution

Study design – A. Ledwoń, M. Skucha-Nowak, P. Dębski
Data collection – A. Ledwoń, J. Mikusek
Data interpretation – P. Jędrusik, P. Dębski
Statistical analysis – P. Dębski, J. Mikusek
Manuscript preparation – A. Ledwoń, M. Skucha-Nowak
Literature research – A. Ledwoń, P. Jędrusik

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