RECIPIES IN DENTISTRY

STUDENTS ABSTRACT BOOK

Researches was presented at the International scientific e-conference "Recipes of Dentistry" organized by Lithuanian Society of Prosthodontics (LOOD), 2020 05 07-21.
Introduction and Aim

It has been agreed that residual cement after cementation of implant supported cement-retained restorations is sometimes related to peri-implant diseases. However, there are quite a lot of clinical situations where cementation is inevitable, especially in the esthetic area.

As there is still a lack of information about selecting the most suitable luting agent or cleaning options of different cement types, the main purpose of this in vitro study was to evaluate the removal feasibility of cement excess after cementing crowns on dental implants while using two different cements. Additional tasks were a) to find out if any cement is more likely to be removed completely; b) to determine which surface of the crown usually contains more cement and c) to determine radiographic examination reliability while trying to detect cement residue.

Methods and Materials

Materials used in this in vitro study: a model with interchangeable gum imitation, 20 individual zirconium oxide abutments, 20 zirconium oxide crowns, 2 different cements: I – Self-Adhesive Resin Cement (RelyX U200, 3M ESPE, USA) and II – Resin-Modified Glass Ionomer Cement (Ketac Cem Plus, 3M ESPE, USA). 10 crowns were cemented using cement I, another 10 using cement II, afterwards precise removal of the cement was performed using a stainless-steel probe and a dental floss by the same researcher. As cleaning was performed consistently from all surfaces, the researcher’s position towards the model was not specified and set. Then each crown-abutment unit was detached from the implant analog, was photographed and analyzed in 4 surfaces: labial, mesial, palatal and distal, resulting in a final sample size of 80. Radiographic examination, computerized planimetric method in “Adobe Photoshop CS6” were used to detect and evaluate ratio between cement residue and entire crown-abutment unit surface. RStudio IDE and IBM SPSS Statistics v. 23 were used for statistical analysis.

Results

Cement II resulted in 7.4% more cement residue on all surfaces (as evidenced by the extremely low p value, p <0.05) than cement I. The p value on L, P, D surfaces was <0.05, meaning that data are significantly different between groups and surfaces. Variables are related. When measured separately in Cement I and Cement II groups, the ratio of residues on the surface D was the highest, M - 1.1% lower than D, L - 2.3% lower than D and P – the lowest (2.7% lower than D).

Fig. 1. Experimental model

Fig. 2. Radiographic evaluation of the model with abutment-crown unit

Discussion

Significant differences in the consistency and flow of two cements were observed during cementation and cement excess removal procedures, which may cause a certain distribution of different cement residues in two groups. Also, it was observed that greater removal of residual cement can cause scratches on implant supported cement retained zirconium oxide crowns and zirconium oxide abutments. Anyway, based on the results of other studies, the probing and flossing technique that we used in this experiment is the best and the safest option for cement excess removal in order not to damage the soft tissues.

Comparing to other corresponding studies, just as in our research results, a higher amount of cement residue was found on the contact surfaces and most distally. Also it is important to note that we still found cement residues in all samples, indicating that all residual cement can not be removed. Our study showed that residual cement detection could not be accurate enough while using radiographic examination. However, there is a possibility that soft tissues may change the results slightly in the clinical situation.

More experiments with more other types of cements and larger sample must be done in order to choose the most suitable cement.

Conclusions

• It was impossible to remove both of the cements excess completely.

• There were more resin modified glass-ionomer cement left undetected after cleaning, meaning that resin cement would be more appropriate to use in this case.

• Most of the cement (regardless of its type) remains on the distal (D) surface, the least were left on the palatal (P) surface.

• Radiological examination is not an effective method for detecting residual cement.

References


Fig. 3. The average ratios of cement residue depending only on the type of the cement.

Fig. 4. The average ratios of cement residue depending only on the type of the cement.

Fig. 5. The distribution of residual cement ratio depending on the cement type and different surface. The box plots do not overlap, so we can state that there are significantly more glass-ionomer cement remains on all surfaces.

Fig. 6. Resin (I) and glass-ionomer (II) cement residuals distribution depending only on the cement type.
Effect of intraoral scanner, printer and digital analog system on the accuracy of 3D printed models

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Introduction and Aim

Fully digital workflow of producing implant-supported restorations involves the use of intraoral scanners (IOS).2 Factors like clinical situation, scanning strategy, hardware and software may influence the accuracy of the digital intraoral impression.4 For implant restorations, the master model is often needed and could be produced with additive manufacturing (3D printing) technologies using IOS data. 3D printed implant models must be fitted with a selected type of digital analogs.3 The clinical fit of an implant prosthesis at the implant-abutment junction is directly dependent on the accuracy of impression and cast.1 The aim of this study was to evaluate the accumulative influence of IOS, 3D printer and digital implant analog on the local and global accuracy of digital implant analog position in 3D printed master model.

Methods and Materials

Reference (REF) model
Two Shiresman BLT 4.1 mm RC implants
Mesial - 0° angulation
Distal - 5° angulation
3Shape scan bodies torqued with 10 Ncm
Calibration spheres ø5 mm (±1 μm)

Table 1: Accuracy of intraoral scanning

<table>
<thead>
<tr>
<th>Dist., μm</th>
<th>V. Shft., μm</th>
<th>Ang.</th>
<th>Local</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34.7 (28.6)</td>
<td>0.293</td>
<td>0.290</td>
<td>65.5</td>
<td>45.5</td>
</tr>
<tr>
<td>0°</td>
<td>0°</td>
<td>0°</td>
<td>0°</td>
<td>0°</td>
</tr>
</tbody>
</table>

Results

Accuracy evaluation of each digital workflow step was performed according to Fig1. Deviations of distance (Dist) between scan bodies, vertical shift (V.Shift), angulation (Ang) and rotation (Rot) were measured using local and global planes (Fig2). Unsinged (absolute) values have been used for the analysis of the results. For the statistical calculations, Matlab (MathWorks, Natick, Massachusetts, USA) was used.

Table 3: Accuracy of digital workflow

<table>
<thead>
<tr>
<th>Printer</th>
<th>Analog</th>
<th>Dist., μm</th>
<th>V. Shft., μm</th>
<th>Ang.</th>
<th>Rot.</th>
<th>Local</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>VueD.</td>
<td>Elos</td>
<td>19.1</td>
<td>0.271</td>
<td>32.0</td>
<td>61.9</td>
<td>4.36E-04</td>
<td>2.02E-04</td>
</tr>
<tr>
<td>Asiga</td>
<td>Elos</td>
<td>19.1</td>
<td>0.271</td>
<td>32.0</td>
<td>61.9</td>
<td>4.36E-04</td>
<td>2.02E-04</td>
</tr>
<tr>
<td>NextD.</td>
<td>NT</td>
<td>22.7</td>
<td>0.320</td>
<td>30.0</td>
<td>60.0</td>
<td>3.02E-04</td>
<td>1.51E-04</td>
</tr>
<tr>
<td>Asiga</td>
<td>NT</td>
<td>22.7</td>
<td>0.320</td>
<td>30.0</td>
<td>60.0</td>
<td>3.02E-04</td>
<td>1.51E-04</td>
</tr>
</tbody>
</table>

Table 4: Accuracy validation of E3 scanner

Table 5: Statistics, Multivariate multiple linear regression:

Discussion

Inaccurate implant prostheses can increase the risk of biological and mechanical treatment complications. The clinically acceptable misfit of implant prostheses varies from 10 μm to 150 μm according to recent studies. The final fit of prostheses on implants is influenced by accumulative effect of many production stages and factors: impression accuracy, accuracy of master model, manufacturing of prosthesis, materials etc. According to recent studies, we have chosen 100 μm distance and vertical shift deviations and 0.4° angulation errors between the implants as clinically acceptable. Rotation was evaluated too. However, it is possible to choose prosthetic elements without rotational features.

Limitations of this study must be considered. This in-vitro situation did not involve saliva, blood, limited scanning space and other factors that might influence IOS accuracy. Scanning all printed models with CMM would be hardly feasible, therefore laboratory E3 scanner had to be included. Global plane, and therefore all global measurements, might have been effected by the accuracy of scanning and 3D printing.

The influence of separate factors in digital workflow is widely studied. In recent study by Revilla-Leon4, MultiJet Printing and Digital Light Processing 3D printers produced models of similar accuracy with control gypsum models. However, there is lack of research about accumulative effect of different factors.

Both the hardware and the software of digital technologies is being constantly updated. Moreover, new protocols for digital workflow in dentistry seem to be emerging. Therefore, further research is needed to include other factors of digital workflow, such as computer aided manufacturing (CAM), different available devices and components.

Conclusions

1. IOS had a significant effect in overall error accumulation in digital workflow, however deviations introduced by IOS are clinically acceptable.
2. ELOS retentive elements ensured more accurate implant analog position than NT-trading system.
3. Asiga MAX UV 3D printer produced a more accurate implant model than NextDent 5100.
4. Vertical shift deviations were lower with 5° tilted implant than with 0°.
5. Statistically significant accumulative effect of 3D printer and analog was seen only with local rotation measurements.
6. Clinically acceptable results were achieved by using Asiga MAX UV 3D printer and ELOS implant analogs.

References

Nowadays dentistry offers a lot of choices to restore dentition. The cheapest ones, at least partly restoring chewing, esthetic function and the most financially accessible, especially for elderly people, are removable dentures. During the past decade, the number of elderly people has increased significantly and in the future it will only rise. However, patients with removable dentures may face some difficulties, e.g. taste disorders, that can lead to alterations in balanced diet that are especially dangerous for old people with chronic diseases and fluid and/or electrolyte imbalance [1]. Aim of the work – find out how the use of new acrylic full upper removable dentures changes the perception of four basic tastes: sweetness, sourness, saltiness and bitterness, and to evaluate the influence of age and gender. This is a base study which is mandatory for differentiation in further studies of age-induced and usage of full removable dentures caused changes in perception of taste, figuring out whether the latter can recover and after what time, whether it is of same nature after using the first prosthet and after using subsequent ones and whether it depends on the material of the prosthet. This data is relevant in the search of healthy nutrition advice for the elderly without eliminating their possibility to enjoy food.

Methods and Materials

This study was performed in LUHS MA Faculty of Odontology Department of Prosthodontics during 2017-09-01 – 2018-02-01 with the permission of LUHS Bioethics Center (protocol No. BEC-OF-39). All the patients for whom during the study period new acrylic upper removable dentures were made were invited to take part, it was not considered whether it was the first or subsequent prosthesis. After eliminating people with immunosuppressive disorders, cardiovascular diseases, patients that refused to participate and needed denture relining 30 (55 – 80 years old) patients have taken part (17 women and 13 men). Sixteen solutions of different substances (four different concentrations each) for four basic tastes were made (Table 1).

The patients were examined twice: without dentures before having their new ones manufactured and after a week of using their new full upper removable dentures. The patients were told to rinse their mouths for 10 s with 20 ml of unknown solution (prior to each solution the patients have rinsed for 10 s with 20 ml of distilled water) starting from the lowest concentration and to identify the taste. For patients who could not identify the taste, a higher concentration solution was given. An incorrect identification was evaluated as inability to identify the taste. According to T. Wada et al. [2] technique, thresholds of concentrations of substances whose taste was identified by patients without and with prosthesis were compared. The time required to identify the taste was measured by the patients using a chronometer. According to T. Ghaffari et al. [3] technique the time required to identify the taste with and without prosthesis was compared. The time was only assessed in cases where the limit of concentration of correctly identified taste was identical both with and without dentures. A 0.95 confidence level (P), 0.05 significance level (p), maximum error of 10% (Δ) were set. Data analysis was performed using Statistical Package for Social Sciences® (IBM, Armonk, USA) version 23.

Results

Assessment of threshold concentrations of solutions

Patients with full upper removable dentures felt sweet (p<0.002) and sour (p<0.0001) tastes statistically significantly weaker than without them (Fig. 1). A tendency was observed that with full upper removable dentures patients felt bitter (p=0.063) and salty (p=0.059) taste weaker than without them (Fig. 1).

There were no trials in this study where the taste felt with removable dentures was of smaller concentration than without them or concentrations where the same, thus the data gathered confirms the results of many authors that the perception of taste is worse for patients with full upper removable dentures.

According to T. Ghaffari et al. [3], the dentures may have impeded natural ventilation between nasal and oral cavities, which was significant for identification of gustatory stimuli in the post-nasal area, and proper mobility of tongue and cheeks, thus disturbing the distribution of moisture, air and heat, required for proper assessment of taste [20].

The sensation of taste may have altered due to increased salivation when using full upper removable dentures noticed by R. N. Tango et al. [5] and due to alteration of chemical composition of saliva [6].

All test participants have identified the taste within 9.52s on average, which was not so different from results obtained by T. Ghaffari et al. [3]. However, more than one second was required to feel and identify the four basic tastes contradicting the results of referred authors. According to the results obtained - women felt bitterness better than men and the age increased the perception of saltiness increased confirmed the opinion of many authors that age and gender may have influenced sensitivity to taste [7].

There could be a possibility to expand the study including more factors which, according to other authors, may influence perception of taste, including: salivation, olfactory sensibility, chronic diseases, harmful habits, properties of the prosthet: material thickness, surface smoothness, volume, construction, previous dentures, habits of life, nutrition, hygiene [7]. A study of such nature is not hard to perform and only negligibly exhausts the subjects, thus can be successfully expanded by many researchers, especially considering that most subjects are elderly.

Conclusions

The results of this study confirm the presumption that acrylic full upper removable dentures were the taste perception of the patients.

1. Patients with full upper removable dentures felt sweet and sour tastes weaker than without them. The same tendency was observed with bitter and salty taste.

2. The time required to identify the basic tastes: sweetness, sourness, saltiness and bitterness, was ~1.56 seconds longer with full upper removable dentures than without them.

3. Independently of the use of full upper removable dentures bitterness was identified better by women than men; identification of saltiness became weaker as the age of the patients increased.

Due to impaired taste recognition and perception, patients who use full removable dentures could choose new and rarely consumed dishes, save their smell and taste and chew them for longer instead of wishing to intensify all tastes, especially sweetening or enlarging the portions of desired flavors.

References

**Introduction and Aim**

Over the lifetime, the surface of teeth is in constant interaction with chemical, biological and physical factors, whose change in balance determines whether the tooth is worn or protected. The presence in the mouth and influence on teeth of acids of non-bacterial origin and/or chelates is a necessary assumption for erosive tooth wear due to which teeth defects appear [1-3]. Scientific research of the past five years has shown that the appearance of tooth defects due to acids of non-bacterial origin is common in developed countries and is the third most relevant odontological issue behind dental caries and gingival diseases. It is an irreversible chronic loss of hard tissues of the tooth thus it is critical to notice the first signs of tooth defects and, should there be indications, start treating them [1-4]. The aim of the work was to determine the opinion of first course students of LSMU MA Faculty of Odontology about prevalence of their tooth defects and of their intensity, need and type of treatment.

**Methods and Materials**

This study was conducted in 2020 with permission from the LSMU Bioethics Center (protocol No. BEC-OF-78). All first course students of LSMU MA Faculty of Odontology were invited to participate in the study. The sample of the study consisted of 18-25 years old 38 students: 34 females and 4 males. The opinion of study subjects about their teeth defects and their treatment was assessed using an online questionnaire survey. The contents of the questionnaire were prepared according to WHO recommendations, broadening the 2018 questionnaire of Jarkander et al. [1]. Answers from the online questionnaire were automatically captured in a Microsoft® Excel® (Microsoft® Corporation, Redmond, USA) worksheet. The subjects answered 29 questions about the symptoms of their teeth defects according to Table 1, need of the dental treatment and its type – direct or indirect restorations. The intensity of dental defects was assessed using a new methodology created for this study by adapting and joining two systems for assessment of registration and diagnostics: Jarkander et al. [1], 2018 (original version: Hasselsvik et al. 2010) for molar teeth and Johansson et al. 1996 for frontal teeth (Fig. 1). Table 1. Criteria for diagnostics and evaluation of intensity of teeth defects.

**Results**

Prevalence of tooth defects according to students’ opinion

Teeth defects were prevalent in 86% of study subjects. All subjects who thought they had teeth defects were women (Fig. 1). Intensity of teeth defects according to students’ opinion

Mild tooth defects occurred 3, moderate – 6 and severe – 17 times for students who had teeth defects. There were no very severe teeth defects (Fig. 2).

Treatment need and its type according to students’ opinion

The percentage of need for treatment (28.9%) did not match the prevalence of tooth defects (86%) (Fig. 3). From the 26 students who have specified they had teeth defects 7 students have specified the required type of treatment and 4 students indicated that treatment is required but did not specify the type. This is a common occurrence in the treatment type prioritized direct restorations (Fig. 4).

**Discussion**

The calculated 68.4% prevalence of tooth defects for first course odontology students in Kaunas, Lithuania was slightly higher than Lithuanian swimmers of the same age (18-25 y/o), for whom the prevalence was 50 % [5]. The same tendency is observed for people of the same age and education in Poland – 59.85% and Ukraine – 42.74% [6]. The opinion determined in this study for almost two of three people to have teeth defects confirms their fast spread among youngsters noticed by many authors [1-4].

Almost two thirds of tooth defects in this study were severe, almost a quarter – moderate, mild defects were prevalent half as much as moderate. These results confirm the research of other authors, that teeth defects are difficulty controlled in their active stages [2, 4, 7].

The opinion in this study – not to treat mild tooth defects with dental restorations – agrees with many authors that in the very first stages of tooth defects the main treatment option is preventive hygiene, nutrition, general health or conservative dental treatment with remineralizing or adhesive materials is enough [3-4]. Two thirds of students with moderate teeth defects confirmed other authors’ opinion to treat them. According to Paryag et al. [3] and Lussi et al. [4], moderate defects must be treated with direct composite or non-prep (veneers, inlays, onlays) restorations. One third of students with moderate defects decided not to treat them at all, rejecting authors' view [3-4]. The results obtained in this study – not to treat severe teeth defects or treat them with direct restorations – did not concur other authors’ opinion to prosthetically treat teeth with partial or full crowns and, if needed, bridges [3-4].

**Conclusions**

1. More than two thirds of LSMU MA Faculty of Odontology first course students think that they have tooth defects.
2. From LSMU Faculty of Odontology first course students, who think they have teeth defects, none indicated that the defects are very severe, almost two thirds indicated they are severe, almost a quarter indicated moderate, mild defects were prevalent half as much as moderate.
3. LSMU MA Faculty of Odontology first course students do not indicate the need to treat their mild teeth defects invisively. Two thirds of students with moderate defects indicated they, but do not indicate the type of treatment. More than half of the students with severe teeth defects would not treat them, almost half would treat them using direct restorations.

The study confirms the globally accepted data that dental defects are becoming prevalent in younger patients, shows odontology students’ basic knowledge about tooth defects, creates an opportunity to further assess the effectiveness and requirement of information provided on the topic, objectiveness of self-analysis and spread of defects in relation to better knowledge about them.

**References**

Introduction and Aim

Full removable dentures – a solution to full dentures for many years, are being replaced by a stable and provoking undisputably more masticatory comfort prostheses fixed on dental implants [1]. It is common for the four implants to be positioned in the frontal part of edentulous jaw [2]. In such systems the most often used metal constructional materials have excellent physico-mechanical survival and good biocompatibility [3]. Polyether-ether-ketone (PEEK), analogous to metals, belongs to high biocompatibility and approximately as stable, also closely resembling bone due to its elasticity and lightweight, is used in traumatology and is becoming increasingly more popular in odontology for fixed prostheses on implants. PEEK are known to be biocompatible and bioinert in hard and soft tissues when present as a bulk form. PEEK is chemically inert with a hydrophobic surface; it does not readily allow protein adsorption on its surface. An inert biomaterial has no adverse reaction or release of ions or constituents [4]. The effect of suprastructure tensisons in the bone is currently a topic of interest [5]. The aim of work was to identify and analyze the summed-up criterion – distribution of bone stress in the implant area using a PEEK prosthesis fixed on four dental implants depending on different positions of the functional loading point on a cantilever in a 3D modeled system.

Methods and Materials

The fragment of the lower jaw with dental implants and over-implant prosthetic part was represented by geometrical 3D models (Fig. 1) and diagonal loads were placed on the distal cantilever of the prosthesis. 3D models were created using “SolidWorks® Student Edition 2018” (Dassault Systèmes SE, France) software in Kaunas University of Technology. The research was conducted after a permit from LSMU Bioethics Center (protocol No. BEC-OF-81).

Description of the analyzed 3D system:
- Fragment of the lower jaw between mental foramina.
- Implant placement in the area of 34, 31, 41, 44 teeth; cylindrical shape, Ø 3.5 mm, 8 mm length, contact point reduced by not modelling outer and inner threads.
- Angle of implant abutment patrix is 15°.
- Screw for fixation of prosthesis is without threads. Other parameters match DC, Alonso AA, Oliveira Dal

Aim

prosthesis and abutment

Comparison

of

Soc. 2017 Jul 1;17(3):255

and

Length and

Ceramic

a solution to full adentia for many years, are being Constructed

Res. 2015 Oct 1;17:e531

Lengths

Width and height of bridge type PEEK dental prosthesis: 10x2.2mm in the Zoidis

Angle of implant abutment NJ, Smith AGC,

Edition. New York: Implant placement in the area of 34, 31, 44 teeth; cylindrical shape, Ø 3.5 from

Restorations

Distribution

JM.

G.

Single sided fragment force of 100N acting on 35, 3

Concept

biomechanical properties were specified for implants and prostheses & [2] was to

Kassebaum

JP,

(2018). The aim of work was to establish that constructional material of the prosthesis could be related to the distribution of bone stress near the implant in an all-on-4 system, but this cannot be confirmed because of inhomogeneous conditions of the studies.

Conclusions

1. This study has shown that the finite element model is an effective method for virtual analysis of stress distribution while modelling the distribution of forces, which is practically impossible in a clinical environment, and would be beneficial for further analysis of distribution of stress and changes of load in a bone-implant-supraimplant construction from PEEK and/or other materials in different scenarios.

2. The conclusion of the study – a full arch restoration in an edentulous lower jaw using a four-implant fixed PEEK prostheses system generates unevenly distributed internal stress in the bone next to the implants but does not go over the critical resistance of the bone.

References


Meehan WP, Chen S, Berzins R, Savino JS, Hwang WM, De Jager AL, et al. Test conditions: Distribution of bone stress in the implant area of the prosthesis was evaluated in the analyzed system while changing the length of the cantilever and the size of the grid of the finite elements around the distal implant (Table 2). The difference between Case 1 and Case 2 was found to be statistically insignificant (p=0.05) by independent samples t-test – the average of Mises stress near all the implants increased when extending the cantilever.

Bone stress in the implant area of the prosthesis was evaluated in the analyzed system while changing the length of the cantilever and the size of the grid of the finite elements around the distal implant (Table 2). The difference between Case 1 and Case 2 was found to be statistically insignificant (p=0.05) by independent samples t-test – the average of Mises stress near all the implants increased when extending the cantilever.

Results

Table 1. Characteristics of materials by “SolidWorks® database”

<table>
<thead>
<tr>
<th>Material, structure</th>
<th>Elastic modulus (GPa)</th>
<th>Poisson ratio (ν)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone</td>
<td>10.63</td>
<td>0.313</td>
</tr>
<tr>
<td>Bone around the implant</td>
<td>12.51</td>
<td>0.313</td>
</tr>
<tr>
<td>Titanium implant’s parts</td>
<td>110</td>
<td>0.3</td>
</tr>
<tr>
<td>PEEK dental prosthesis</td>
<td>3.9</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Table 2. Average of the stress in the bone with full arch lower jaw PEEK prostheses fixed on four implants by different cantilever length during functional load

<table>
<thead>
<tr>
<th>Case 1</th>
<th>Case 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(grip 0.25–0.5 mm)</td>
<td>(grip 0.15–0.45 mm)</td>
</tr>
<tr>
<td>35</td>
<td>4.22</td>
</tr>
<tr>
<td>45</td>
<td>2.82</td>
</tr>
<tr>
<td>50</td>
<td>2.79</td>
</tr>
<tr>
<td>105</td>
<td>1.94</td>
</tr>
<tr>
<td>115</td>
<td>1.79</td>
</tr>
<tr>
<td>125</td>
<td>1.67</td>
</tr>
<tr>
<td>175</td>
<td>1.27</td>
</tr>
<tr>
<td>225</td>
<td>0.94</td>
</tr>
<tr>
<td>Difference of averages</td>
<td></td>
</tr>
<tr>
<td>35-36</td>
<td>5.59</td>
</tr>
<tr>
<td>36-37</td>
<td>7.74</td>
</tr>
<tr>
<td>37-33</td>
<td>13.33</td>
</tr>
</tbody>
</table>

Bone stress in the implant area of the prosthesis was evaluated in the analyzed system while changing the length of the cantilever and the size of the grid of the finite elements around the distal implant (Table 2). The difference between Case 1 and Case 2 was found to be statistically insignificant (p=0.05) by independent samples t-test – the average of Mises stress near all the implants increased when extending the cantilever.

The implant closest to the point of loading receives the highest load. The distal implant on the same side as the point of loading, depending on the exact point loading, receives 45.01-53.88% of all forces created. Stress at the frontal implants is distributed almost evenly, a bigger part is received by the implant on the same side as the loading. The pair of implants on the same side of the loading force suffers 66.38-74.68% of all forces. In the modelled system, the implant on the opposite side of the loading force receives the smallest stress which is hardly influenced by the length of the cantilever.
NEUTRAL ZONE CONCEPT USE IN PATIENTS WITH HIGHLY ATROPHIC ALVEOLAR RIDGE: A CLINICAL CASE

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Introduction and Aim
Making comfortable dentures for edentulous patients with highly atrophied alveolar ridge is a challenge even these days, when new technologies such as intraoral scanners and All-on-4 prostheses take an important role. Sometimes contraindications for implantation lead doctors to find an alternative to implants and look back to conventional protocols. In order to achieve the best result, a balance between masticatory muscles has to be reached, so that neutral zone method takes a considerable part in prosthetic treatment [2,4,5]. We have found other studies for neutral zone concept and used this technique [1,4].

The aim of the study was to investigate the satisfaction in edentulous patients after wearing dentures that were fabricated using the neutral zone concept, to evaluate this method by giving a patient a questionnaire.

Methods and Materials
An electronic systematic review was performed by using PubMed, Science Direct and Willey databases. Appropriate articles were analysed in English and were included into clinical cases to analyze the technique making process [1,4]. 5 edentulous patients had contraindications for implantation because of the financial status. Accordingly, a neutral zone concept was adjusted by creating new prostheses for patients with highly atrophied alveolar ridges [2,3].

Technique of the neutral zone (NZ) concept includes inserting one additive visit for a patient than usually. The main point is that by taking one more impression we can record a space for mandible teeth that is created by soft tissues [5]. The beginning of the treatment is the same as in conventional method and by customizing wax rims a maxillomandibular relationship is recorded. After that, a technician has fabricated a base from acrylic resin for mandibular alveolar ridge, inserted 2 metal loops in the middle to create retention points for impression material and 2 loops on each side, which connected “stoppers” to maintain the VDO, which was determined previously (Figure 1). During the next visit, wax rim of the upper jaw and occlusal vertical dimension “stop” of the lower jaw were mounted into patient’s mouth, tissue conditioner impression material was inserted above the mandibular base and a patient was asked to imitate movements like swallowing, counting from 60 to 70, pronouncing words like “mississippi” (Figure 2). After that technician has made silicone matrices to mark the NZ space and inserted plastic teeth into the wax (Figure 3,4,5). In accordance with lower denture, upper teeth were adjusted (Figure 6).

Results
Scientific articles were included into this clinical case. In accordance with them, clinical examination was performed and removable complete prostheses were indicated. 4 of 5 patients used to have dentures that were made by conventional method before. These patients were satisfied with NZ dentures after our treatment. 1 patient experienced prosthetic treatment for the first time and his expectations were fulfilled. They had to fill questionnaires after 2 months using new dentures in order to evaluate the comfort. All the patients claimed that stability and retention of present prostheses is better now than the latter prostheses and now it is easier to chew and talk (old prostheses were balancing due to anatomical ageing changes of alveolar ridge, whilst the base of old dentures did not change their form and discrepancy between them has appeared).

The reason why NZ dentures are convenient is the torque and direction of artificial teeth. It is shown in the pictures below (Figure 7,8). Photos represent the approximate differences of the lower artificial teeth positions on alveolar ridges – NZ artificial teeth were more centered on the alveolar ridge, conventional dentures were more tipped to the front.

Discussion
Prosthetic dentistry requires reconstruction of the functional masticatory system as well as high quality aesthetic view. Even though the neutral zone technique is not always the best option for making the most esthetic version of prostheses (as we evaluate them from the side profile prospective), it results in the most comfortable complete removable prostheses by maintaining stability and retention.

By placing lower artificial teeth on the wax base by following the tongue and vestibular matrices, here appears the balance, which is created by soft tissues – tongue, cheeks and lips while talking, chewing, swallowing, laughing. So that a patient does not feel disbalance or it is reduced significantly.

Differences between patients profiles from side show off the disparities between conventional and NZ concepts. The direction and the torque of artificial teeth creates the volume of the lips – conventional dentures usually boosts them more than NZ dentures. Nevertheless, the function is more important than esthetics. It is inevitable to mention that we cannot categorically compare old and new prostheses, because we do not know the information about anatomical and physiological aspects of old dentures when they were fabricated years ago. It would be unethical to abuse old prostheses, so that by this case we can greet that our NZ concept was successful.

Conclusions
Even though implantation and All-on-4 prostheses method would be the most comfortable treatment, this had to be rejected in our cases because of the financial status. So that complete removable dentures appeared as a solution for these patients. Hopefully, we can achieve high comfort in making dentures for edentulous patients in a relevantly not expensive and simple way. We have confirmed that this method takes more time by creating prostheses, but the value is worth spent time and patients can indulge themselves in eating.

It is necessary to mention the part of notes on patient consent. All the patients were informed about NZ technique, they were acknowledged that it is not a new method so that it will not cause any harm or reduced well-being. Patients voluntary wanted to participate and signed on their treatment plans. Due to COVID-19 we did not get permission to publish their pictures yet, so that we have described it in the text.

References