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Survey on the Current Clinical and Technological Level of Implant Prosthesis Application and Its Complications among Romanian Prosthodontic Specialists

Ligia MUNTIANU[a], Luminita OANCEA[b], Mihaela PANTEA[b], Andrei MACRIS[b], Cristina BODNAR[b], George ION[b], Eugenia PANAITESCU[c], Catalin GAGIU[b]

[a]Complete Denture Department, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

[b]Occlusion and Fixed Prosthodontic Department, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

[c] Medical Informatics and Biostatistics Department, Faculty of Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

ABSTRACT

Objectives: *The present study aims to identify the current level of clinical and technological performance of dental prosthetic rehabilitation on implants and the possible existence of correlations between different designs and occurring complications in Romanian practice.*

Material and method: *An online questionnaire with 36 questions, grouped into five sections, has been designed using the Google Forms application. In 2019, it was approved by the Romanian Dental and Maxillofacial Prosthetic Society, and the link to the questionnaire was distributed* via *email to 70 members. The answers with multiple choice option were summarized in an Excel document, coded and statistically processed in the specific software (SPSS v20.0; IBM Corp). Fisher's exact test, likelihood ratio and linear-by-linear association were used, and pairs of two questions were tested considering a standard statistical significance p value=0.05.*

Results: *The results show that screwed rehabilitations (80.5%) on platform switched (70.9%) bone level implant (76.4%) with multiunit (69.1%) abutments for fixed total prosthesis, and custom abutments (43.6%) for removable prosthesis are preferred in Romanian practice. Most common problems of fixed rehabilitation on implants are related to aesthetics (65.5%) and for overdenture to unscrewing (56.4%).*

Address for correspondence:
Luminita Oancea, MD, Lecturer
17-23 Plevnei Route, sector 1, Bucharest, Romania
Tel.: +40732477977
Email: luminita.oancea@umfcd.ro

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Resin-polymerized material in the laboratory, acrylic teeth and milled metallic structure in both arches was the preferred design for fixed restauration in both arches. Multiple statistic significant correlations ($p<0.05$) were found between the design type and complications.

Conclusions: *Our findings outline current clinical and technological preferences in Romanian practice on prosthetic implant rehabilitations, illustrating a great need for further research and education consensus.*

Keywords: dental implant, implant prosthesis, prosthetic complications, prosthodontic specialist.

INTRODUCTION

Currently, there is a rapid evolution of materials, design possibilities and virtual modeling protocols in treatment of partial and total edentulous patients by implant-supported fixed prosthesis. Studies showed an increased demand for dental implants, which became a very important part of modern dentistry (1-3). While dental industry is constantly innovating and bringing new materials and technologies to the market, one training option in implant dentistry is delivered through industry-sponsored courses, which facilitates the use of specific products or devices. Given that clinicians often face challenges in implementing complex restorative solutions as well as managing accidents and complications during their therapeutic approaches, it becomes evident that education curriculum upgrade is urgently needed. In 2009, the European Workshop on Implant Dentistry University Education published a consensus report that supports the integration of implantology in predoctoral curriculum (4-6). Nowadays, there are postgraduate and specialist programs which facilitate an evidence based critical approach and achievement of specific skills in implantology in the United States, United Kingdom, Scandinavian countries, and Israel (7).

Only few studies identify preferred methods of restoration in certain areas of the world (8, 9), and some of them do not provide information about professional experience (10, 11).

The present study aims to identify the choices made by prosthodontic specialists in the clinical protocol, the materials and technical modalities used in the realization of fixed and removable prosthesis on implant support and the most common problems currently facing this solution in Romanian practice. ❑

MATERIAL AND METHOD

An online questionnaire has been developed using the Google Forms application. It was first submitted for analysis to the executive board of the Dental and Maxillofacial Prosthodontic Society and its final version was approved in November 2019. The survey was then distributed *via* email to all 70 members of the Society who were invited to participate. Previous experience in prosthodontic rehabilitation on implants was the main condition for participation. Of all invited members, 55 responded (response rate 78%). Answers were summarized three months after launching the survey. The questionnaire included 36 questions, grouped into five sections: demographic and experience data, treatment planning and clinical protocols, material selection and manufacturing preferences, mechanical complications of the fixed prosthesis on implants, and indications and complications of prosthodontics on implants.

Multiple choice questions provided respondents with multiple answer options and were designed to cover most of the probable responses. Also, efforts have been made to minimize the bias effect of responses; therefore, whenever other choices were possible, the answer "other" was provided, with a request for clarification from the respondent. For questions with numerical answers (*eg*, preferred number of implants), answer options were presented in ascending order. The results were summarised in an Excel document, coded and statistically processed using the specific software (SPSS v20.0; IBM Corp). ❑

RESULTS

In the first phase of the study, a frequency analysis of each option was performed, followed

by an analysis of statistical significance. Thus, a potential association between variables was explored by using Fisher's exact test, likelihood ratio and linear-by-linear association; also, pairs of two questions were tested, each answer correlation with each option of the second one, considering a standard of statistical significance p value close to 0.05.

Demographic data, career status and experience of respondents

Respondents, of whom 67.3% were women, had an average age of 36 years, with a minimum of 25 years (7.3%) and a maximum of 63 (1.8%).

Respondents were mostly clinicians working in private practices, one third of them being involved in University clinic and none retired (Figure 1). Regarding the number of years of experience, 47.3% of respondents had less than 10, and the remaining ones, in relatively equal proportions, between 11-20 years and 21-30 years.

Most respondents made over 21 crowns and bridges on implants, and in an equal percent (41,8%), over 21 and less than 5 total reconstruction on implants were performed. We could conclude that the study group had above average experience (Figures 2-3).

Treatment planning and clinical protocols

Type of retention of the fixed prosthesis on implant – Regarding the method of retention on implant, the vast majority of practitioners prefer screwing (80.5%).

Options offered by the questionnaire revealed that 61.8% of dentists use titanium abutment, with custom abutment being ranked 2nd in order of preferences. To the "other" option, two respondents added straight/angled/calcinable abutment.

The ideal number of implants indicated in planning of the total fixed prosthetic on implants – For the question regarding the ideal number of implants indicated in full-arch, implant-sup-

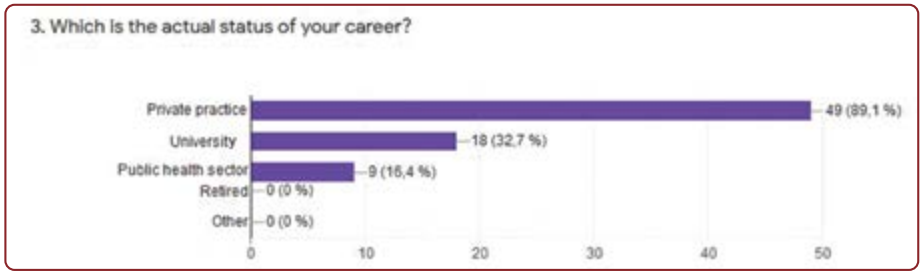
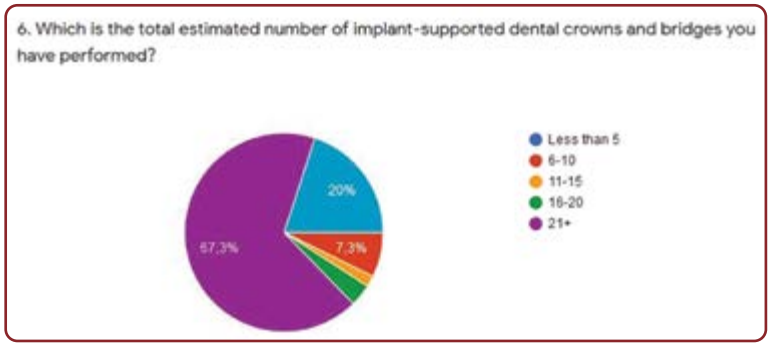
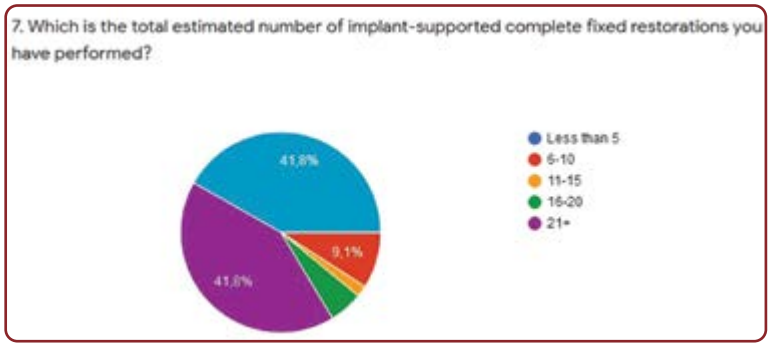


FIGURE 1. Respondents' career status



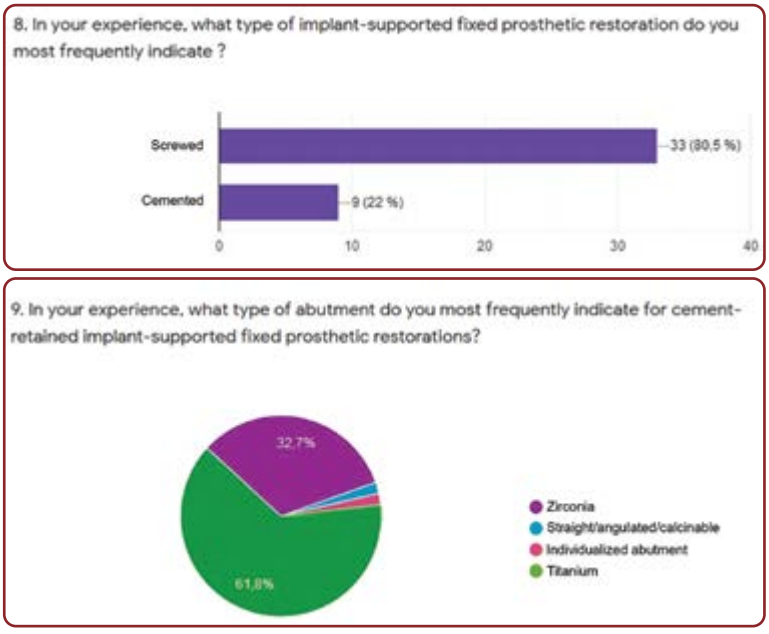


FIGURES 2-3. Number of crowns and bridges made on implants – number of total fixed prosthetic restorations on implants

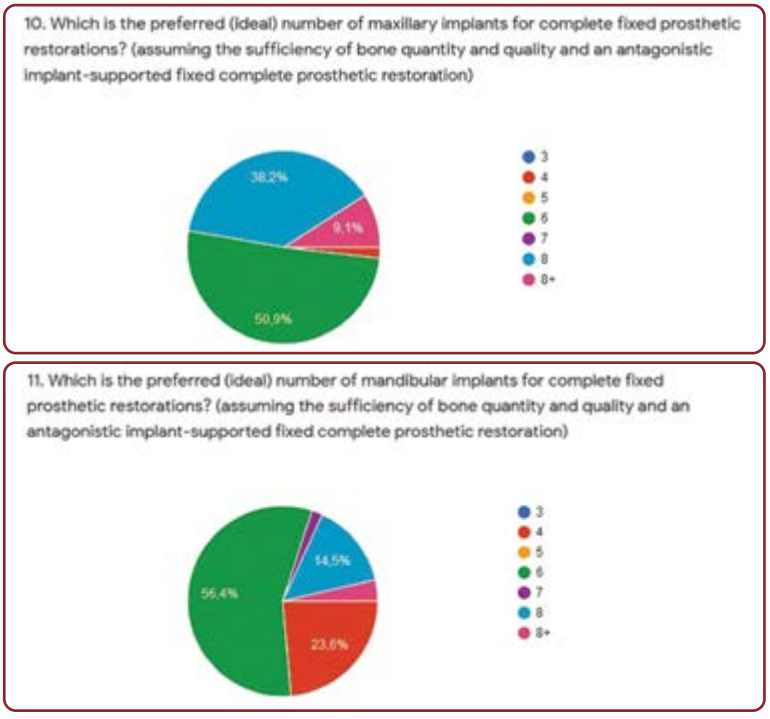
ported, fixed prosthetic treatment (considering the situation of a sufficient quantity and quality of bones and a full implant bridge as antagonist), the main option was 6 for both arches.

Preferred type of implant and platform in full-arch, implant-supported, fixed prosthetic treatment – In the realization of a full fixed implant restauration, the majority of clinicians prefer bone level implants (76.4%) (Figure 8), platform switched (70.9%) or both (25.5%) (Figure 9). Most dentists use multiunit abutments for all implants (69.1%), while 23.6% do not use intermediate parts (Figure 10).

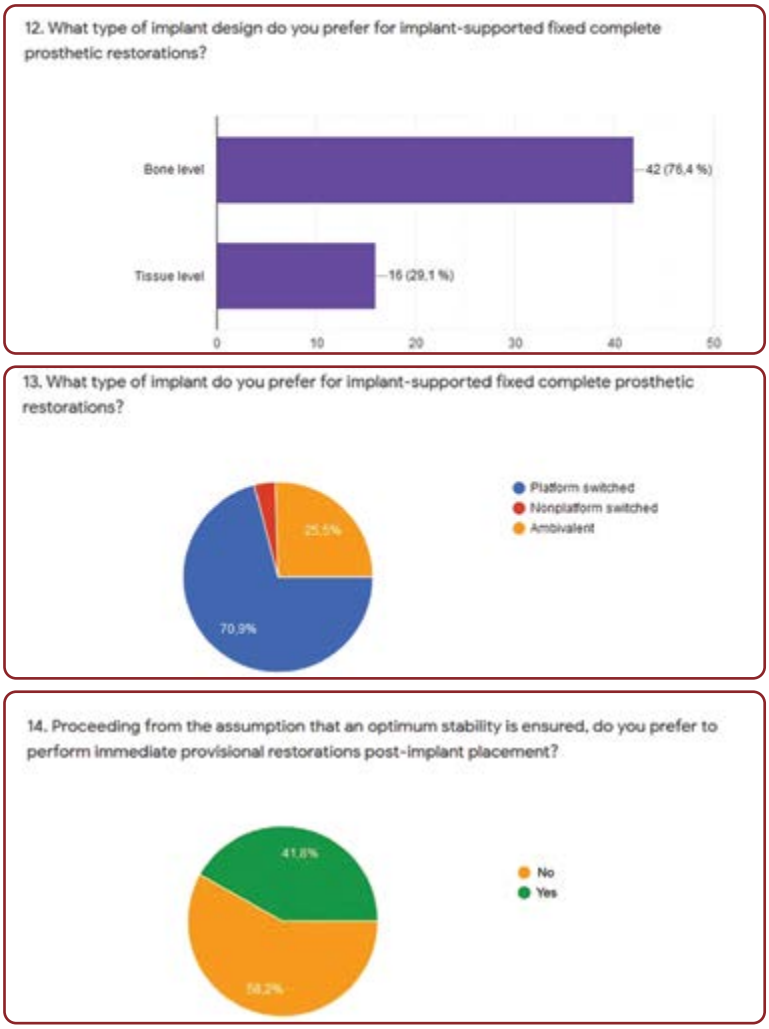
Temporary restorations on the fixed prosthesis on implants – Of all respondents, 58.2% stated that they performed temporary prosthesis immediately after surgery, with 40.6% of them using it in 48 hours postoperatively and 25% immediately after surgery. Most of those who resorted to temporary prosthesis (74.2%) used indirect methods with laboratory intervention (Figures 11-12-13).



FIGURES 4-5. Type of retention of the fixed prosthetics on implant. Type of prosthetic abutment in implant prosthetics



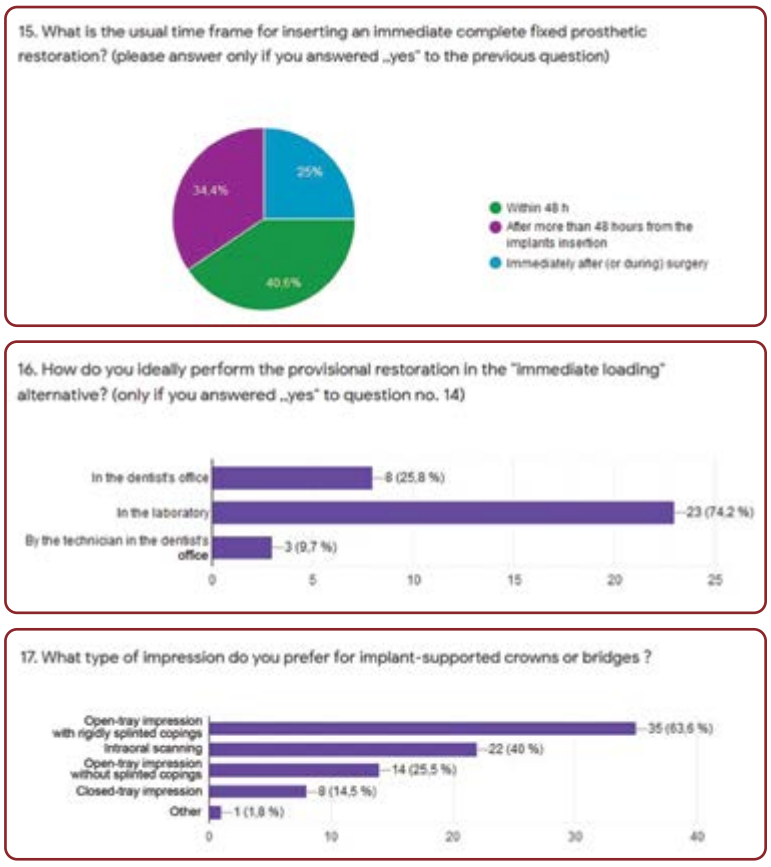
FIGURES 6-7. The ideal number of maxillary and mandibular implants, respectively, indicated in total fixed prosthetic on implants



FIGURES 8-9-10. Preferred implant design for prosthetics all fixed on implants. Type of implant for total prosthesis fixed on implants. Preference for using multiunit abutment

Type of impression made in the fixed prosthetics on implants – In the case of fixed rehabilitations on sectorial areas, the main choice for both sectorial or full arch restorations on implants was the open tray technique with rigidly splinted transfers, 43.6% of respondents always using a verification jig made of acrylic material; however, 50.9% of clinicians do not use any verification guide. Testing the possible correlation between clinical experience and preferred type of impression in order to achieve full arch restorations on implants, the likelihood ratio test indicates a significant difference between percentages (p=0,037179) and a correlation with option of open tray without splinted transfers, which is usually chosen by experienced doctors (over 31 years).

Retightening of screws after applying the restoration – Tightening of screws in a subsequent appointment for performing implant restauration is common for only 52.7% of respondents, with 14.5% never performing this maneuver. There is a statistically significant association between clinical experience and proactive retightening of screws (p=0.0,008429) (Table 1). The combination of clinical experience and option of never retighten the screws shows a significant difference (p=0.023744) between answers on age categories (11.1%, 0.0%, 38.5%, 0.0), without being possible to detect a linear association. The combination of clinical experience and option of sometimes retighten the screws shows a significant difference between percentages (70.4%, 42.9%, 30.8%, 0.0%) and a trend of statistically significant linear decrease (p = 0.007457) (Table 1). Those with little clinical experience use to retighten the screws mostly inconstantly. For the option to always tighten the screws there is a significant difference between response rates (18.5%, 57.1%, 30.8%, 100.0%) depending on the age category (p=0.036722), but this cannot be detected linearly. Among



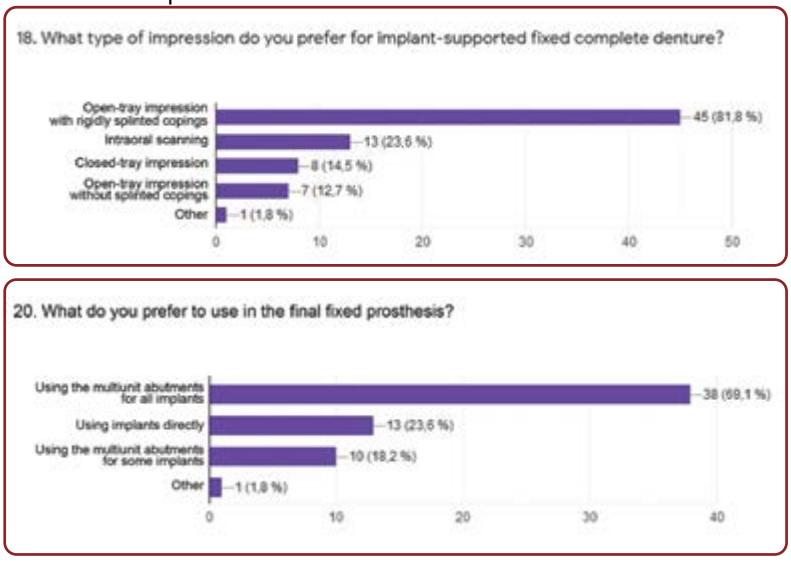
FIGURES 11-12-13. Use of immediate temporary restauration right after implant placement. Preferred moment for temporary restauration application. Technical modality to make the immediate partial prosthesis after implant placement.

respondents with extensive clinical experience (31-40 years), the highest percentage ticked the affirmative answer of this option (Table 1).

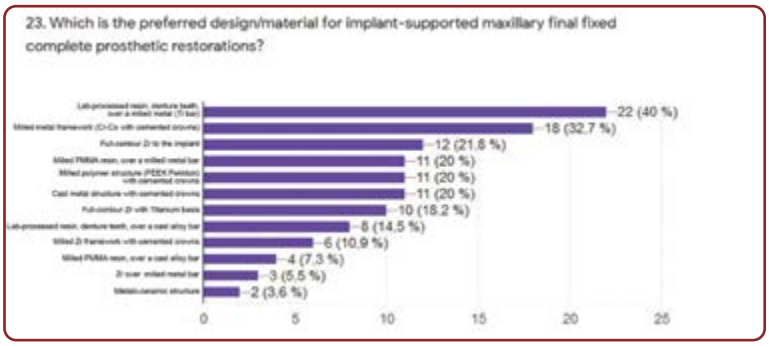
Selection of material and technology for the manufacture of full fixed implant restoration

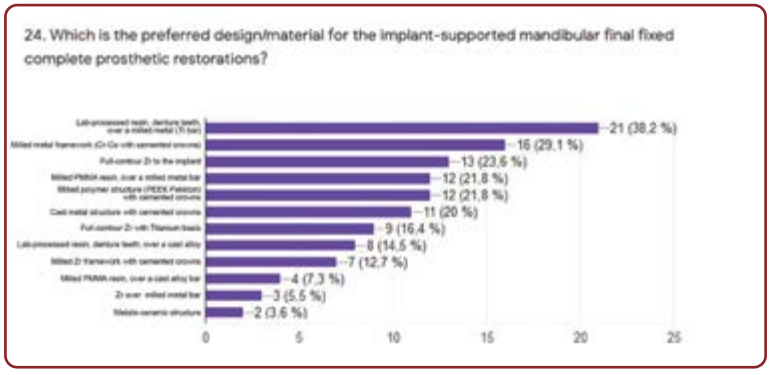
During the planning of implant restoration, 78.2% of respondents take into account the presence of the same type on the opposing occlusal faces. For the full fixed implant maxillary restoration, the most frequently accessed solution is acrylic resin laboratory processed, acrylic teeth and the milled metal structure both in the maxilla and mandible.

The second option most frequently ticked for both arches was CrCo structure milled with cemented crowns.

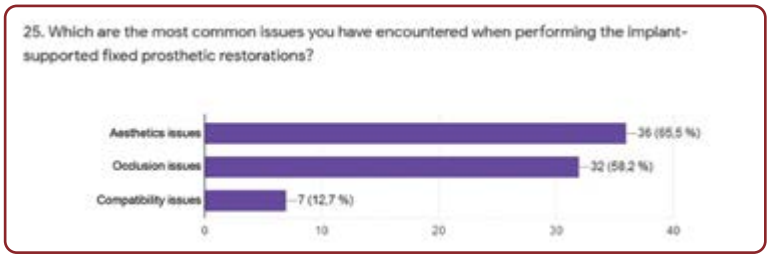


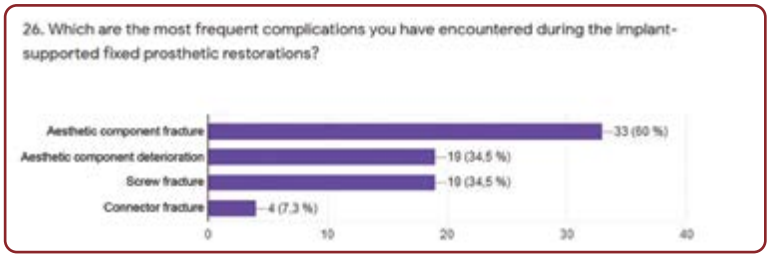
FIGURES 14-15. Type of impression used for crowns and bridges on implants. Type of impression used for full arch total prosthetics on implants

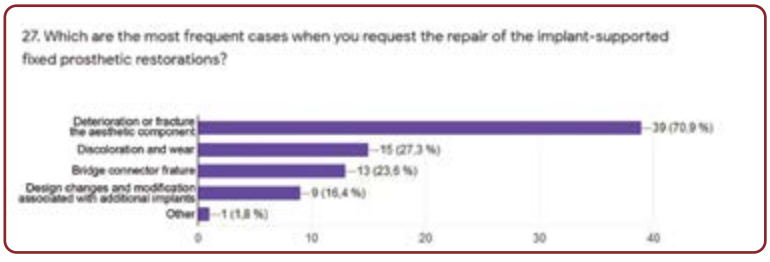




FIGURES 16-17. Preferred design/material for maxillary full fixed definitive implant restoration. Preferred design/material for mandibular full fixed definitive implant restauration







FIGURES 18-19-20. The most common complications encountered in fixed prosthesis on implants. The most common issues encountered in fixed prosthesis on implants. The most common situations in which repair of fixed prostheses on implants is required

Regarding the association between the level of experience and choice of restoration options for laboratory polymerized resin, acrylic teeth, milled metal structure, the likelihood ratio test indicates a significant difference (22.2%, 57.1%, 53.8%, 100%), but this cannot be detected; there is an ascending linear trend, sometimes depending on the clinical experience, which is statistically significant ($p = 0.014189$) (Table 1).

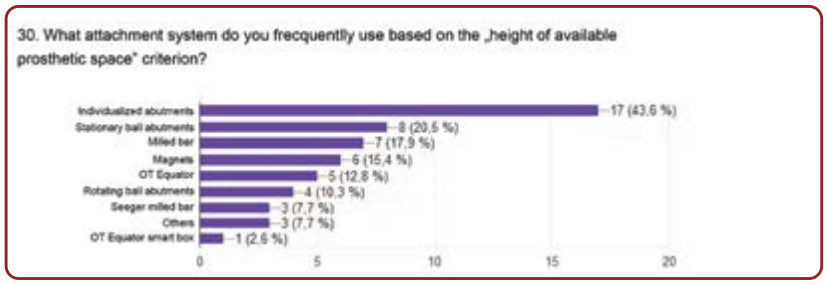


FIGURE 21. Preferred attachment system in implant overdenture

TABLE 1.

Crosstab 4. Which is your medical/clinical experience?	Likelihood Ratio p_value	Linear-by-Linear Association p_value
21. After implant supported restauration is fixed, do you retorque the abutment screws at a follow-up visit?	0,008429	-
21. After implant supported restauration is fixed, do you retorque the abutment screws at a follow-up visit? **C. Never**	0.023744	**0.101760**
21.After implant supported restauration is fixed, do you retorque the abutment screws at a follow-up visit? **B.**Sometimes	0.044043	0.007457
21. After implant supported restauration is fixed, do you retorque the abutment screws at a follow-up visit? **A.** Always	0.036722	**0.105771**
23. Whichisthepreferred design/material for implant-supportedmaxillary final fixed complete prosthetic restorations? **B.** Resin material polymerized in laboratory, acrylicteeth, milled metallic structure	0,039113	0,014181
23. Whichisthepreferred design/material for implant-supported maxillary final fixed complete prosthetic restorations? **E.** Zirconia complete crowns on implants	0,028889	0,025439
23. Which is the preferred design/material for implant-supported maxillary final fixed complete prosthetic restorations? **E.** Milled metallic structure (Ti, Cr-Co) with cemented crowns	0,046517	-
24. Which is the preferred design/material for the implant-supported mandibular final fixed complete prosthetic restorations? **D.** Milled PMMA, milled metallic structure	**0,084481**	0,035997
24. Which is the preferred design/material for the implant-supported mandibular final fixed complete prosthetic restorations? **H.** Milled polymer structure (Peek, Pekkton) with cemented crowns	**0,108305**	0,036145
24. Which is the preferred design/material for the implant-supported mandibular final fixed complete prosthetic restorations? **K.** Cast metallic structure with cemented crowns	**0,071195**	0,013578
18. Wha ttype of impression do you prefer for full fixedimplant-supported restaurations? **B.** Open-tray impression without rigid solidification of transfer copings	0,037179	**0,396511**
26. Which are the most frequent complications you have encountered during the implant-supported fixed prosthetic restorations? **A.** Screw fracture	**0,100288**	0,022963

For the option of total zirconium crowns on implants in maxillary restorations, the likelihood ratio test indicates a significant difference between percentages (33.3%, 28.6%, 0.0%, 0.0%), a linear decreasing trend that is sometimes statistically significant (p=0.025439), depending on the clinical experience (Table 1).

Sometimes there is an ascending linear trend, depending on the clinical experience, an association that is statistically significant (p=0.046517), when opting for restoration of milled metal structure (Ti, CrCo) with cemented crown. On a linear decreasing trend of the use of milled PMMA material/design and milled metal structure, mandible restoration can be observed (25.9%, 14.3%, 0.0%, 0.0%), depending on the clinical experience, which is statistically significant (p = 0.035997) (Table 1).

Also, there is an increasing linear tendency of using material/design of the milled polymer structure type (Peek, Pekkton), with cemented crowns in the mandible according to the clinical experience, which is statistically significant (p= 0.036145); this time, most of those who prefer it are experienced doctors (31-40 years) (Table 1).

The trend of linear growth of the use of material/design of metal-type structure with cemented crowns, depending on the clinical experience, proves to be statistically significant (p=0.013578), the solution being chosen especially by experienced doctors (Table 1).

Mechanical complications of fixed prosthesis on implants

The most frequently reported complications in fixed restoration on implants are related to aesthetics (65.6%), but more than half (58.2%) of dentists also report occlusal problems. Among mechanical complications, the fracture of aesthetic component (60%) is reported in the first place, followed by screw fracture and aesthetic component wear (34.5%). Thus, repair of aesthetic component ranks first among requests for repair of fixed prostheses (70.9%). However, 61.1% of doctors do not address any measure to prevent the cracking of aesthetic component in the molar area.

The association between the occurrence of the screw fracture with the clinical experience is statistically significant (p=0.022963), without an established linear correlation (Table 1).

Testing the combinations of the preferred design/material for full fixed implant maxillary restorations and the most common mechanical complications encountered in treatment by fixed prosthesis on implants, a statistically significant positive correlation (p=0.006333) appeared between screw fracture and milled metal structure (Ti, Cr-Co) with cemented crowns, cast metallic structure with cemented crowns – deterioration with fracture and aesthetic component (p=0.022928).

In the association between design/preferred material for the final full fixed mandibular implant restoration and the most frequent mechanical complications encountered in treatment with full fixed implant restorations, there is a statistically significant correlation (p=0,036145) between fracture of aesthetic component and restoration of polymerized resin material in the laboratory, acrylic teeth, and metal structure cast, while screw fracture is statistically significantly correlated with the option of milled polymer structure (Peek, Pekkton) with cemented crowns in full fixed mandibular implant restoration (p=0,013578) (Table 1).

Indications and complications of overdentures restorations on implants

Regarding the overdenture restorations on implants, the minimum number of implants was four (62,5 %) in the maxilla and six in the mandible (50%), with the most frequently used retentive system being custom abutments (43.6%) (Figure 19). Among accidents which appear in this type of treatment, 71.1% were related to overdenture components, 56.4% being represented by unscrewing. ❑

DISCUSSIONS

The questionnaire conducted on a group of prosthodontic specialists, members of the Society of Dental Prosthetics and Maxillofacial, highlighted the following aspects:

- In Romanian dental practice, fixed screwed rehabilitations at the implant level on titanium abutments are preferred, which is in opposition to Chowdhary's study (10), where cement-retained prosthesis was the restoration approach chosen by most dentists across countries participating in the survey
- There are divergent opinions regarding the preference of the number of implants to provide support for total fixed rehabilitation of the maxilla and mandible, the largest number choosing the option of 6 in both arches. In the questionnaire study conducted among Pacific Coast members Society for Prosthodontics in 2019 (1), the number of those who chose 6 for maxilla was similar (56%), but the minimum number of implants selected was 4. The situation for the mandibula was different, American prosthodontists voting in relatively equal percentages between options of 4.5 and 6. Romanian clinicians considered the optimal implants option (38.2%), which was not voted by any participant in the American survey.
- For full arch fixed implant rehabilitation, most respondents expressed their preference for bone-level implants, ascending statistic significant correlated with clinician's experience. Romanian prosthodontists mostly use platform switched with the use of multiunit components for all implants, while American specialists (8) equally vote for platform switch and ambivalent. Proactive retightening of screws is performed only sometimes by half of participants in the present survey, similarly to other reports in the literature (8), with a statistically descending correlation with experience. In proportion of 58.2%, Romanian prosthodontist do not use immediate temporary restorations after implant placement, and of those who practice it, 40.6%

perform it within 48 hours with the participation of the dental technician, while in the American group (8), the majority vote (79%) is for immediate restauration or during the surgical procedure and realization by direct technique in the office (72%).

- The most popular impression technique, both for single unit or bridges (63.6%) and full arch implant restorations (81.8%), is the open tray with rigid splinting of transfer systems inserted at the level of implants; only half of cases (49.9%) are using checking devices (jig) from acrylic, gypsum, PMMA, while American practitioners use a resin jig to check the position of implants in a much higher percentage. The results of a study performed in Israel in 2017 (9) showed that their prosthodontist specialists chose mainly open tray impression technique, while general dentists' preferences were standard tray impression technique.
- In most cases there is a clear preference for the same material on the opposing faces of antagonistic rehabilitations, and the most commonly used technological option in full arch rehabilitation is the resin-polymerized material in the laboratory, acrylic teeth, milled metallic structure in both arches. This finding is similar to that of Schoenbaum's study as far as the mandible is concerned (8), but for the maxilla, only 18% of American doctors opted mostly for zirconia crowns on titanium base (33%). While the structure milled by CrCo with cemented crowns was the second option for Romanian doctors, American practitioners voted for lab-processed resin, denture teeth, over a milled metal (Ti) bar at maxilla and zirconia crowns on Ti-base on the mandible. In our study, the results show an ascending correlation between years of practice and restorative choice for both arches implant restauration for resin-polymerized material in the laboratory, acrylic teeth, milled metallic structure and milled CrCo structure with cemented crowns, milled polymer structure (Peek, Pekkton) with cemented crowns in the mandibular arch. Also, there is a descending correlation between experience and option of implant zirconia total crowns in the maxillary implant rehabilitations and milled PMMA resin over a milled metal bar in mandibular implant restorations.
- The most frequently reported problems of fixed rehabilitation on implants are related to aesthetics; thus, fracture of aesthetic components is considered to be the most common accident in practice, and damage of aesthetic components is in the top of repairing request. Despite these reports, 61.1% of physicians did not take any measures to prevent cracking of physiognomic materials. Our statistical analyses show an ascending correlation between experience and screw fracture. Also in our correlation analysis, the preferred definitive prosthesis design/material for the maxilla was significantly associated with specific complications, such as Zr over milled metal bar with esthetic problems, lab-processed resin, denture teeth, over a cast alloy bar with occlusion problems, milled metal framework (Ti, CrCo) and cemented crowns with screw fracture, cast metal framework with cemented crowns with repair request due to damage or breakage of the esthetic component. For the mandible, the preferred definitive prosthesis design/material was significantly associated with specific complications, such as full-contour Zr to the implant and esthetic problems, milled metal framework (Ti, CrCo) with cemented crowns and occlusion problems, lab-processed resin, denture teeth, over a cast alloy bar with fracture of the esthetic component, milled polymer framework (PEEK, Pekkton) and cemented crowns with screw fracture. In the light of these results, further studies should be conducted to investigate these possible associations and their causes.
- Regarding overdentures restorations on implants, Romanian prosthodontists prefer a minimum of four implants in the maxilla and six in the mandible. This treatment modality, being known to improve oral functions (12), was preferred by most dentists worldwide, with variation in the number of implants used for treating their mandibular edentulous patients (10); even McGill consensus statement suggests that for the restoration of an edentulous mandible, two implant-retained over denture should be the first choice of the treatment (13). The most commonly used retentive system voted in our study is custom abutments, and the accidents which appeared were related to overdenture components, more than half of them being represented by unscrewing.

Interpreting and using study data needs to take into account that the survey is limited to a single prosthetic organization and geographical

area, and it represents just a snapshot of specialized opinions related to implant prosthetic restorations. ❑

CONCLUSIONS

The results show that, in Romanian practice, screwed rehabilitations on bone level implants with multiunit abutments are preferred for fixed prosthodontic solutions and custom abutments for removable prosthesis. Most common problems of fixed rehabilitation on implants are related to aesthetics and for overdenture to unscrewing. Resin-polymerized material in the laboratory, acrylic teeth, milled metallic structure in both arches was the preferred design for fixed restoration in both arches. Multiple correlations were found between the design type and complications, illustrating a great need for further research and education. ❑

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