The development of new classes of dental materials determined the apparition of reinforced polymers, as BioHPP and Trinia, used for core in non-metallic prosthetic restorations, including in implants non-metallic superstructure. The purpose of the study was to present the results of the comparative clinical trials referring to the use of BioHPP and Trinia resins as core in fixed prosthetic rehabilitation. The researches were performed on 33 patients in which we realized 71 fixed prosthetic restorations. According to the six evaluation criteria used in research, we conducted biannual monitoring meetings over two and half years period for registrations of comparative results in the use of these two reinforced polymers as core. The results of the study demonstrated that both type of these materials exhibit a certain degree of elasticity and presents many advantages, therefore these represent a beneficial acquisition in patients oral health.

Keywords: BioHPP, Trinia, fixed prosthetic restorations, comparative evaluation

The prosthetic restorations are currently achieved of increasingly evolved materials, in accordance with the biofunctional and biomechanics requirements of the orofacial system rehabilitation [1,2]. The problematic aesthetics of dental alloys and their mechanical, thermal, electrical, allergenic and biological properties induced the developing of researches regarding the obtaining of compatible non-metallic biomaterials. Among these are included BioHPP and Trinia reinforced polymers for non-metallic restorations. BioHPP-Bredent is a polymer based on polyether-ether-ketone (PEEK) and is used in dentistry for realization of the fixed and movable core, including superstructure on dental implants. The strength of BioHPP is the consequence of the filler with a special ceramic of the very small grain size (between 0.3-0.5 µm), introduced into the polymer structure for the optimisation of mechanical properties, by producing constant homogeneity due to the grain size, which is an important prerequisite for consistent quality [3]. The aspect of BioHPP polymer and of restorations achieved by BioHPP polymer are presented in figure 1 [4].

Trinia-Bicon is a CAD/CAM multi-dimensional polymer, reinforced with multi-layered glass fiber kept together by epoxy resin. This biomaterial present low specific weight, is machinable and non-combustible, with high bending and compressive strength and is used for the achievement of crowns and bridges on dental or implant-supported abutments, but also for framework for movable restorations with implant aggregation (fig. 2) [5].

Dentists are confronted daily with treatment dilemmas for their patients and ideally, the treatment decisions should be based on scientific evidence, combined with the patient desires and the clinician’s experience [6]. Rating scales were developed for several factors that were considered relevant to the problem of clinically evaluating dental restorative materials [7]. In order to carry out a correct clinical investigation of dental materials and/or techniques, most researchers use the Ryge criteria for assessing the studied restorations. In 1980, Ryge published the measurement scale as a standardized method for the clinical evaluation of the restorations [8]. Researchers often adapt the criteria in an effort to make them more discriminating for modern restorative materials, with the consequence that there are many so called modified Ryge criteria in use [9].

The purpose of the study was to evaluate comparatively the observed differences in the registered results of the clinical trial after the application of Ryge modified criteria’s, referring to use as core of BioHPP and Trinia reinforced polymers in fixed prosthetic rehabilitation.

Experimental part
Material and methods
The researches were conducted during the period 2014-2017 in the Dental Medicine Faculties of Tirgu-Mures, Bucharest and Cluj-Napoca Universities, respectivelly in Constanta. The 33 selected patients (17 females and 16 males) were aged between 35 and 54 years (44.5 years ± 9.5 years). The selected group of patients signed the informed consent for participation after having provided a
complete explanation of the aim of study and committed to attend the biannual recalls for two and half years. After recruitment, oral hygiene instructions were given to all the patients and prophylaxis was performed to establish optimal plaque control and gingival health. Each selected patient had the need at least two of fixed restoration on natural or implant abutments, in order to achieve at least two fixed restorations in the same oral cavity, one of BioHPP core and one of Trinia core. The inclusion criteria in this study were represented by the patients aged 35-54 years, with dental conditions which requiring oral rehabilitation with at least two fixed restorations (FRs) on natural tooth or/and implant abutments, with healthy overall condition and with good dental hygiene (with maxim plaque index = 1). The exclusion criteria were represented by not proper age, smokers, pregnancy, disabilities, systemic diseases, severe medical complications, pre-malignant and malignant lesions, atypical gingival proliferation, soft tissues/tongue tissues hyperplasia, heavy occlusal contacts or bruxism, allergic history concerning methacrylates, plaque index higher than 1. The clinical and technical procedures for achievement the fixed prosthetic restorations with BioHPP and Trinia core were standardized before the start of the investigation, after a written detailed protocol.

We performed 71 crowns and bridges, 36 restorations on 44 natural teeth and 35 implant-supported fixed restorations on 42 implants. All restorations were achieved by same dental technician of the research team. Furthermore, aiming to secure a blind study, patients and examiners were unaware of any data from the randomization process. In figure 3 are presented the distribution of the patients by gender, age, number of fixed restorations (FR) and number of abutments.

The steps for the achievement of BioHPP core were: abutments preparation (teeth/impression posts), impression of prosthetic field, impression pouring, obtaining the stone casts, scanning of casts, computerized design of the Trinia core with PI Dental CAD/CAM Processing System, milling the Trinia discs with Cobra 4 PI Denta milling machine, the covering of Trinia core with the aesthetic layers of Gradia GC composite resin and light-curing in Sibari SR 620 lightpolymerizator. Occlusion was adjusted. In the cases of implant-supported abutments, the cementation of fixed restorations (crowns or bridges) with BioHPP core were performed in dental office with Variolink dual cement. The cementation of fixed restorations with Trinia core were veneered with the light-cured composite resin Gradia GC for indirect restorations and light-cured in Sibari SR 620 lightpolymerizator and than, the occlusion was adjusted. In the cases of implant-supported abutments, the BioHPP core were blasted, a special varnish were applied inside of the cores and than were light-cured and cemented on the implant abutments extra-oraly in laboratory with Variolink dual cement. Cements of fixed restorations (crowns or bridges) with BioHPP core were performed in dental office with Variolink dual cement too. Phases in the achievement of a restoration with BioHPP core are presented in figure 4.

The phases for achievement of fixed restorations with Trinia core were: abutments preparation (teeth/impression posts), impression of prosthetic field, impression pouring, obtaining the stone casts, scanning of casts, computerized design of the Trinia core with PI Dental CAD/CAM Processing System, milling the Trinia discs with Cobra 4 PI Denta milling machine, the covering of Trinia core with the aesthetic layers of Gradia GC composite resin and light-curing in Sibari SR 620 lightpolymerizator. Occlusion was adjusted. In the cases of implant-supported abutments, the cementation of fixed restorations with Trinia core were veneered with the light-cured composite resin Gradia GC for indirect restorations and light-cured in Sibari SR 620 lightpolymerizator. Occlusion was adjusted. If it was necessary, a new occlusal adaptation was performed, followed by finishing and polishing. Phases in the achievement of a fixed restoration on Bicon implant with Trinia core are presented in figure 5-7.
The purpose of good occlusal adaptation was to reduce the apparition risk of damage in interrelated tissues of the masticatory system, and to enhance the circumstances for realization of a healthy function. After the adaptation period to crowns and bridges achieved of BioHPP and Trinia core (2 weeks), we conducted biannual monitoring meetings, over two and half years period (also six sessions), with the registrations of comparative results after the used criteria. In total were carried 6 registrations of the selected criteria in the included patients to study. Modified Ryge criteria used in this study are presented in Table 1. Alfa (A) value indicated that conditions were clinically ideal; Bravo (B) ratings indicated clinical acceptability; Charlie (C) and Delta (D) ratings were not noted at baseline monitoring meetings, at six months and at one year, because were not conclusive.

### Results and Discussion

The registrations in according with the detailed criteria, were realized after the examinations of patients, during the six monitoring meetings. Table 2 summarizes the recorded results in percentages and in reference to the criteria set, after the evaluation period of two and half years. At the first, second, third and fourth recall (at 6, 12, 18 and 20 months), all restorations received alfa score (A) with respect to each evaluation criteria. At the fifth recall, we observed in one single restoration with BioHPP core (=2.77%) the discoloration, modification of marginal integrity and gum problems. At the sixth recall, we observed in one single restoration with BioHPP core (=2.77%) the discoloration, modification of surface texture and gum problems, but modification in marginal integrity was depisted at two fixed restorations (=5.55%). The results of study releaved that after 30 months of monitoring no modifications were depisted in the fixed restorations with Trinia core. Allergic reactions of the oral mucosa soft tissues in contact with the fixed restorations were not noted (=0%). After six follow-up, all restorations were in function and no fissures or fractures were detected. At the end of study, the percentage of the differences in the fixed restorations with BioHPP or Trinia core were not significant and demonstrated the good clinical performance of both reinforced polymers.

We note that after all monitoring sessions, only one patient experienced more than one of the criteria listed above, and this patient represented our limit case. In figure 8 is presented the image of intraoral aspect of fixed restorations in P. R. patient (53 year old) with a crown with BioHPP core on second lower right premolar (4.5) and a superstructure with Trinia core on Bicon implant in the area of 4.6. The image was realized at sixth monitoring session. Differences in discolorations, in surface texture and in marginal integrity between the two fixed restorations are visible. This case represents the limit case of our study.

The results of the study demonstrated that both type of reinforced polymers presents many advantages, therefore...
these materials which exhibit a certain degree of elasticity, represent a beneficial acquisition to the oral health of patients. Also, reinforced polymers, because their resiliency, elasticity and ultralight biocompatibility, are more efficient, aesthetic and cost-effective alternative to casted metal core/frameworks or milled in zirconia/titanium frameworks. In addition, restored edentations with milled Trinia core crowns or bridges, realized by extra-orally cemented fixed restorations on Bicon implant abutments represent a facility both for physicians and for patients comfort.

The new classes of dental polymers are reinforced with special glass beads or chopped glass fibers. Glass fibers increase the rigidity of the polymers to a value approximately equal to that of a thermally hardened thermoplastic denture base, but these glass fibers used for reinforcement also have disadvantages and patients undergoing such restorations should be warned not to erode the external and internal surface to avoid free exposure to the extremities of these glass fibers, which causes irritation of the oral mucosa on which they are inserted [10-12]. Of all evaluated restorations, we observed only in the extremities of these glass fibers, which causes irritation of the external and internal surface to avoid free exposure to the extremities of these glass fibers, which causes irritation of the oral mucosa on which they are inserted [10-12].

Conclusions
With the limitations of this study, due to the low number of cases, the following conclusions can be draw:
- The type of core-material material did not signification influenced the results.
- The results suggest that the success rate of tooth-supported and implant-supported BioHPP and Trinia core crowns/bridges were adequate.
- The type of the achievement BioHPP and Trinia core is quite complex, requiring both expertise and proper endowment.
- Well-designed studies with larger patient groups and longer follow-up times are needed for the correct comparative trials of restorations with core/framework of BioHPP and Trinia reinforced polymers.

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