Abstract

**Aim** The aim of this work is to verify the rate of success and failure causes of 32 FRC-FPD (Fiber Reinforced Composite Fixed Partial Dentures) placed on 30 adolescents with dental agenesis, over a follow-up period of 5 years.

**Materials and methods** Our study sample involved 30 subjects (10 males and 20 females) aged between 13 and 17 years who have been rehabilitated with FRC Maryland bridges to treat agenesis of maxillary incisors (for a total of 32 FRC-FPD). The observational study spans 5 years following the general rules coded by the modified United States Public Health Service (USPHS) system.

**Results** After 5 years of follow-up of a sample of 32 FRC-FPD bridges, 30 were still in effective use (so 2 were excluded). All the bridges were FRC, replacing a missing lateral incisor, and had a double wing retention. All requirements of stability, peripheral seal and morphology preservation were well satisfied. The two failed bridges had a structural failure after about two years from placement.

**Discussion and conclusion** In adolescents our orientation about the edentulous rehabilitation is towards solutions that, when possible, provide an acceptable aesthetic and functional restoration with fixed partial dentures, or removable dentures in cases of severe oligodontia. Obviously, techniques involving the placement of dental implants before the end of skeletal growth were never adopted. In our study FRC bridges showed a great functional performance and good compliance from young patients. Considering the positive cost-benefit ratio and the reversibility of the treatment in case of failure, such interventions can be considered a highly reliable early rehabilitation. Further studies are necessary to verify the maintenance requirements tested for longer periods.

**Keywords** Fiber reinforced composite; Maryland bridges; Upper lateral incisor agenesis.

Introduction

It is well known that edentulism, whether acquired as a result of traumatic injury or congenital, should require early intervention, either prosthetic, orthodontic or conservative, in adolescents and young adults. Among the most common causes of such condition are tooth agenesis (2 to 10% of the population) [Nordgarden et al., 2002] and dental loss due to traumatic events [Andreasen et al., 2007]. Our department policy is to treat such cases with the use of the Maryland FRC (fiber-reinforced composite) bridges: fixed partial dentures that can be used to replace a missing tooth in adolescents and adults.

Fixed partial dentures (FPDs) are proposed as alternative to the traditional Maryland bridges that use a metal framework [Vallittu et al., 2000; Vallittu, 2004; Bohlsen and Kern, 2003] with two or more terminal retentive wings and a girder bridge with an artificial tooth to replace the missing one, and are cemented with zinc oxyphosphate or glass ionomer cement [Creugers et al., 1994]. In the 90s the adhesive technique has allowed the development of FPDs in reinforced composite materials [Edelhoff et al., 2001] with various types of reinforcing fibers [Dyer et al., 2004; Behr et al., 1999; Ellakwa et al., 2001; Lassila et al., 2002], which developed into the Targis/Vectris system, (Ivoclar-Vivadent, Schaan, FL and FibreKor; Jeneric/Pentron, Wallingford, CT) and which appears to be the first of a series of direct and indirect rehabilitation techniques.

Despite the improved performance, in the literature this type of rehabilitation is often considered with limited indications and for short periods of time [Tredwin et al., 2007]. The aim of this observational study is to verify the rate of success and failure causes of 32 FRC-FPDs made with dual wing proximal retentions morphology, and placed in the mouth of 30 adolescents, aged between 13 and 17 years, for the treatment of upper lateral incisor agenesis, with a follow-up period of 5 years.

The present study aims to clinically evaluate the survival rate of FPDs made of composite resin and glass fibers (FRC) [Garoushi et al., 2007; Monaco et al., 2003], and cemented with adhesive technique, according to the Targis/Vectris method, subsequently upgraded with Adoro Vectris (SR Adoro/Vectris, Ivoclar Vivadent) [Behr...
Materials and methods

Our study sample involved 30 subjects (10 males and 20 females) aged between 13 and 17 years who had been rehabilitated with Maryland bridges FRC to treat agenesis of maxillary lateral incisors (for a total of 32 FRC-FPD) [Garoushi et al., 2008; Kangasniemi et al., 2003]. The observational study lasted 5 years and was conducted at the Prosthodontic Division at the Department of Surgical Sciences, University of Cagliari (Italy), between the years 2002 to 2007 and subsequently monitored until the year 2011 with annual periodic recalls. Monitoring followed the methods and rules which are encoded by the United States Public Health Service (USPHS) modified system [Cvar and Ryge, 2005], with very strict exclusion criteria.

Prosthetic rehabilitation

All FRC-FPDs replaced a maxillary lateral incisor (18 right and 14 left, for a total of 32 teeth, as only 2 patients had bilateral edentulism). The edentulous space measured on average 5.5 mm (minimum 4, maximum 7 mm) and in 21 patients it was obtained after orthodontic normalisation of the arches, while 9 patients did not need a previous treatment (Fig. 1).

All FRC bridges used as abutment the mesial-palatal surface of the adjacent canine and central incisor distal-palatal surface (Fig. 2, 3). Teeth were prepared using diamond burs of medium grain (Komet, USA) ball or pear shaped, the removal of the dental tissue had an average size extension of 4 mm on the incisor palatal surface and 3.5 mm in the canine tooth. Depth of the preparations was an average of 1.2 mm and in deeper areas, whenever possible, within the enamel thickness.

All FRC-FPDs were made by the same operator between 2002-2007, using the same equipment and operative technique. Regarding the precision impression, it was employed the double impression technique, with polyvinyl siloxanes (putty and wash technique), using standard impression trays and materials of the President line (putty and light Coltene-Whaledent, Switzerland). Fabrication of the dental prostheses was made by the same dental laboratory (owner of the Targis/Vectris regional license), that provided the bridges ready for cementation (Fig. 4). Fabrication required on average 3 working days. The laboratory made 32 FRC-FPDs with dual wing proximal retention [Keulemans et al., 2008]. The thickness of the prosthesis was variable, but never below 2.0 mm in the connection zone between the pontic and the retentive wing.

After try-in of the bridge (consisting of the passive housing of FPD verification, first check and control of the correct occlusal peripheral closure), we proceeded to the tooth area isolation; whenever possible this was
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Screening method and follow up

Monitoring of the 32 FRC FPDs, from 2007 to 2011, was scheduled with annual checkups. In case of fracture or detachment of the prosthesis, which required an intermediate appointment, the bridge was withdrew from the controls. During the visit two operators of equal professional level, independently assessed all FRC-FPDs with conventional methods: use of a probe to evaluate the margins and morphology of the bridge, plane mirror, additional illumination, and following the general rules coded by the modified USPHS system, which includes the four following standards of judgment.

1. FRC-FPD Suitable, without open margins.
2. FRC-FPD Functional, without open margins, but with mild morphological loss.
3. FRC-FPD Functional, but with marginal infiltration and need for interventions.
4. FRC-FPD Not functional, structural fracture or detachment.

Points 3 and 4 entail exclusion from the control sample. Contrary the FRC-FPD catalogued in point 2, if subjected to mild oral interventions (polishing and/or replacement of worn material) were maintained in the study sample. Assessments by the two operators were compared and in cases of discrepancy we proceeded with a new common evaluation.

Results

After 5-years 30 FRC-FPD bridges were still in effective use, with only 2 FRC bridges excluded from the study. All 30 bridges were FRC-type, replacing agenetic maxillary lateral incisor, with a double wing retention. The requirements of stability, peripheral seal and morphology preservation were satisfied. As for the two failed bridges, they underwent structural failure [Van Heumen et al., 2009] after about two years from placement due to moderate bruxism of the two patients that had not been sufficiently investigated in the preliminary visit. It was possible to repair these two FRC-FPD without removing them from the oral cavity. None of the 32 FRC-FPD presented open margins, which is sign of good cementing technique and good patient oral hygiene in these areas.

Discussion and conclusion

The data show that the partial rehabilitation of edentulous anterior areas, with a maximum width of 7 mm, can effectively be performed with FRC-FPD bridges [Tredwin et al., 2007; Durey et al., 2011; Garoushi et al., 2008]. FRC-FPD bridges showed a great functional and aesthetic performance, in fact, at the end of the observational period 30 out of 32 FRC-FPDs, were still being used effectively and with a good compliance by the adolescent patients. It was observed that the double wing-pontic design of the FRC-FPD showed a good performance in the anterior sector. The 5-year follow-up also showed that these bridges should be placed in areas with easy access for oral hygiene and must be cemented in absence of humidity with peripheral margins in contact with the hard dental tissues (in fact, no prosthesis presented a fault referable to the absence of such features). It is finally established the need for careful dental occlusal control of the prosthesis with respect to the opposing dental arch in order to prevent the occurrence of occlusal overload, which must be avoided in the transitional areas between wing/pontic;
these have been proven to be the weakest areas (two manufactured appliances have, in fact, presented faults attributable to overload, although related to bruxism).

In conclusion, this observational clinical investigation showed that FRC-FPD bridges can be considered in adolescent patients a viable alternative to traditional removable and also fixed prostheses (i.e. fixed partial dentures, implant-supported crowns) when used under strict controlled conditions and respecting the safety parameters which apply to all adhesive restorations. Their favourable cost-benefit ratio compared to traditional rehabilitation techniques, the reduced amount of dental tissue to be removed, together with the reversibility of the treatment in case of failure (important in patients in younger age) are factors that must be carefully considered.

Further tests must be performed to verify the correct maintenance of FRC-FPD bridges, and studies with follow-up longer than 5 years are desirable.

References