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ABSTRACT

The loss of an anterior tooth can affect a patient psychologically and socially. This trauma can be minimized by the immediate replacement of the lost tooth, preferably using a fixed prosthesis. This paper describes the immediate replacement of anterior lost teeth by using fibre reinforced composite materials, although these techniques can be employed very successfully in the replacement of posterior teeth as well.

The abutment teeth can be conserved, with little or no preparation, making this procedure truly minimally invasive and keeping the technique reversible. Additional advantages are that the procedure is completed at the chairside in a single visit, thereby avoiding laboratory costs and saving time while waiting for the finished prosthesis. This technique can be used as an interim measure or as a permanent prosthesis.

CLINICAL RELEVANCE

The technique presented is a simple, aesthetic, cost-effective and minimally invasive way of replacing the crown of a tooth. It also provides cost effective treatment for those in the community who cannot afford conventional tooth replacement.

INTRODUCTION

All of us, as clinicians, at one time or another, have had to attend to dental emergencies involving severely fractured or even lost anterior teeth. Replacing such a tooth normally involves the service of a dental technician and there is always a time factor involved – this adds to the emotional and psychological trauma of the patient. Compounding the situation are monetary implications that in today's financial climate and diminishing medical aid remuneration can easily prevent a patient from getting dental treatment.

Fibre reinforced composites are not the ultimate solution for lost tooth replacement. However, in a clinical situation this reversible and cost effective procedure, which is minimally invasive and aesthetically and biologically desirable offers a viable alternative to conventional replacement of lost teeth.

TECHNICAL BACKGROUND

The principle of fibre reinforcement involves the incorporation of thin filaments into a base resin. These filaments impart increased flexural strength, fracture resistance, fatigue strength and increased tensile strength (the surface configuration of each filament has intrinsic mechanical roughness which helps to lock the filaments into the composite mass). The resin is isotropic in nature. The strength of the resulting structure depends on the volume of fibres embedded in the resin matrix. The greater the number of fibres, the better the strength characteristics, provided that complete wetting of the fibres can still take place. Goldberg and Burnstone[1] found the optimum mixing ratio to be 43 to 45 per cent fibre by volume. Although carbon and kevlar fibers were initially used, these have largely been superceded by high density polyethylene, glass or polypropylene in bundles of 10 to 20 microns which give a more natural appearance.[2]

When considering fibre reinforcement one has to distinguish between long, continuous, unidimensional fibres and short fibres as used in fibre reinforced composite products such as Restolux SP 4 (Lee Pharmaceuticals). In the case of the latter the fibres are short (300µm), randomly arranged and the material is isotropic. In fibre reinforced bridges such as described by Bjork et al[4] the fibres are long, continuous, and arranged in specific axes to resist forces in a specific direction and the material no longer behaves isotropically.

Most of the fibres available commercially today are pre-impregnated with resin. This means that the fibres have been impregnated with a low viscosity resin in the laboratory during the manufacturing process. The impregnation process is completed at the chair by "wetting" the fibres with a low viscosity resin, of which a large number are currently commercially available. Complete wetting of the fibres is crucial to achieving maximum strength.[2] The internal reinforcement system of the fibre is composed of silane etched glass. This eliminates the need for a special cutting device.

LITERATURE REVIEW

Replacing lost anterior teeth using the acid etch technique has been described by a number of authors (Jenkins).[5] A cause for concern was the fracture of the composite on the proximal contacts (Buonocore[6], Jenkins[5]).

The use of undercuts on the adjacent teeth (Stolpa),[7] edgewise orthodontic wire (La Vecchia et al),[8] and self-threading pins (Wiltshire and Ferreira)[9] have been tried to overcome this problem, with little or no success.

Clinical studies to investigate the long term clinical performance of direct resin bonded pontics are few (Al-Wahadni and Hussey).[10] Four month's survival of an individual case was reported by Stuart.[11] Sheer and Silverstone[12] reported 14 cases that survived over a 14-monthperiod. Kochavi, Stern and Grajower[13] reported that 62% of their cases were not functioning at 48 months. Both Jenkins[5] and Jordan et al[14] concluded that the failure rate of fibre reinforced composite material was due to internal cohesive failure and not due to failure of the resin to enamel bond, indicating the need for stronger resins.

The failure of the direct technique for bonding pontics to provide a long lasting restoration gave rise to the indirect resin bonded bridge or Maryland bridge in 1982 (Al-Wahadni and Hussey).[10] The literature shows conflicting results as to the life span

Figure 1:

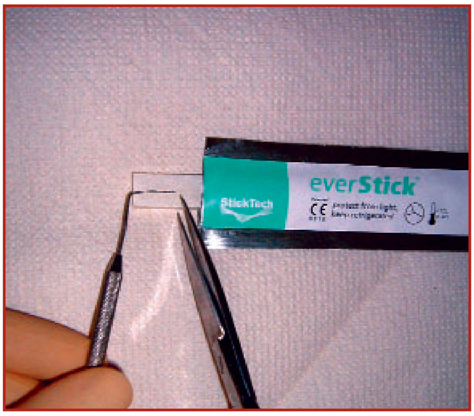

Figure 2:

Figure 3:

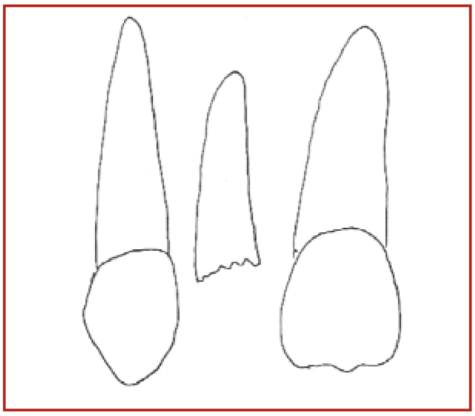

Figure 4.1 Vignette: Pre-op

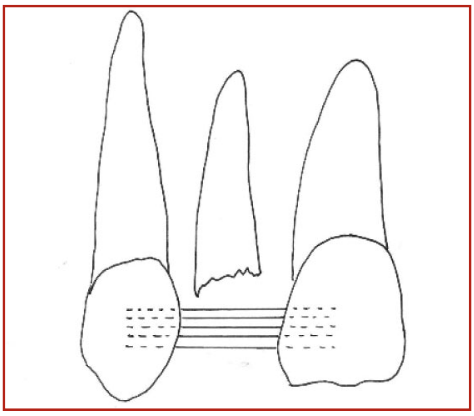

Figure 4.2 Vignette: Fibre framework bonded

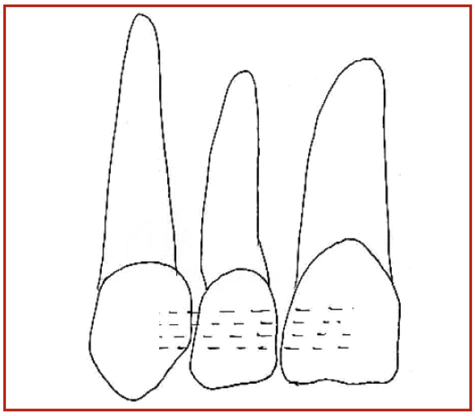

Figure 4.3 Vignette: Completed composite restoration

Figure 5:

Figure 6:

Figure 7:

Figure 8:

Figure 9:

Figure 10:

Figure 11:

of Maryland bridges (Creugers et al[15] Hussey and Linden[16], Hansson and Moberg[17]). Furthermore, metal bonded bridges are aesthetically unpleasing as the metal decreases the translucency of the bonded tooth.

Hence the question: how can one reinforce the composite in order to provide an aesthetically pleasing, metal free, minimally invasive, long lasting and financially affordable restoration? Fibre reinforcement for composites, that was brought to the attention of the dental world by a publication by Ladizeski[18], prevents crack propagation by creating a chemical bond between the strengthening fibre and the composite, (Rudo).[19] Tests have shown that fibre reinforced composites demonstrate rigidity and a flexural strength seven times that of particulate composite resin alone (Goldberg and Freilich).[20] When used appropriately, the strength parameters can be increased by 400-500% (Belvedere).[21] Additionally, the flexure strength is comparable with that of fixed partial denture alloys (Freilich et al).[22] As far as fatigue strength is concerned, fibre reinforced composites are in fact considerably stronger than cast metal alloys (Vallittu).[23] Few failures were reported over a four year period (Auplish and Darbar).[2] The main reason for failure was incomplete wetting of the fibers (Auplish and Darbar).[2] This problem has been addressed by the introduction of pre-wetted fibres developed by Stick Tech Ltd in Finland. Five year functional intra-oral survival rates of 93% were reported by Vallittu[24] employing these pre-wetted fibres embedded in a polymer resin matrix.

CLINICAL CASE REPORT 1

Two days before Christmas 2003 an elderly patient presented at the surgery of Dr van Rensburg with a fractured 12. The root was non-vital with no sign of previous root canal treatment. The restoration on the 11 showed signs of secondary caries. (Fig. 1) It was decided to construct a direct fibre reinforced bridge in order to replace the lost 12. This procedure, as well as all alternative treatment options and cost implications, were discussed with the patient.

The material chosen was EverStick® Crown and Bridge Fibres from Stick Tech Ltd, as only the EverStick® product range from Stick Tech Ltd has pre-wetted glass fibres embedded in a polymer matrix. The fibres are pre-impregnated, silanized glass fibers in a multiphase polymer resin matrix (combination of thermoplastic and thermosetting polymer) with a polymethylmethacrylate rich resin sheath. The fibre bundle contains some 4000 fibers, resulting in a flexural strength of between 900 to 1280 MPa, comparable to that of chrome cobalt denture alloy. The required length of the fibres was measured using a perio probe and cut with scissors. (Fig. 2) It was then stored protected from light while the teeth were prepared. The unsound filling on the 11 was removed with a high speed turbine drill with water coolant and all secondary caries was removed. The mesial and palatal surfaces of the 13 was cleaned with a slurry of pumice and water. No further tooth preparation was done on the 13. The stump of the 12, the 11 and the 13 were acid etched using 37% phosphoric acid, thoroughly rinsed, dried and treated with a bonding agent (Optibond Solo Plus® Kerr-Hawe). The fibres were bonded to the disto-buccal cavity on the 11 and to the mesio-palatal surface on the 13 using Filtek® Flow (3M ESPE) as a luting cement. Note how the bundle is flared in order to achieve a larger area of adhesion. (Fig.3) On this bonded fibre framework a composite crown was constructed with Z100® MP (3M ESPE) employing the layering technique. The embasure spaces were blocked out with wooden wedges. It was decided to leave wide open interproximal embrasure spaces mesial and distal of the 12, aiding this 78 year old patient in plaque control. After completion of the restoration the occlusion was adjusted in centric and eccentric positions in order to reduce functional forces in the restoration. No rubber dam isolation was used in this case, as the tooth was fractured at gingival level. It must be stressed that employing an isolation technique should be done whenever possible in order to control the moisture and to achieve optimal bonding. Oral hygiene instructions were given to the patient and the patient was shown how to use superfloss.

One hour later, after the minimally invasive procedure, the patient went home with a fixed, durable, aesthetically pleasing, and metal free restoration. Final polishing was done after 24 hours. (Fig. 5 and 6)

CLINICAL CASE REPORT 2 - an immediate anterior cantelever bridge

A patient from the UK, on holiday at a nearby golfing estate in South Africa, fractured the root of her upper left second incisor. She subsequently lost her porcelain veneered metal crown that was anchored to the root with a metal post. She attended the surgery of Dr van Rensburg as an emergency case, as she was due to return to her home in England the next day and was horrified by the possibility of having to do without her front tooth. After the extraction of the fractured root, a rubber dam was placed. (Fig. 7)

The caries and the old tooth-colored filling on the mesio-buccal aspect of the 23 was removed, providing the clinician with a retentive slot. (Fig.8)

A fibre framework using EverStick® Crown and Bridge (Stick Tech Ltd) fibres was constructed and imbedded in the cavity of the upper left canine, using Filtek® Flow Composite (3M-ESPE) as a luting cement after the tooth was etched, bonded with Optibond Solo Plus® (KerrHawe) and light-cured for 30 seconds. The rest of the cavity was restored with Z100® MP Restorative (3M-ESPE). (Fig. 9) A pontic was built up on the sturdy fibre framework using the layering technique and Z100® MP Restorative (3M-ESPE) composite. The patient could return home with her smile intact. As the healing process continues, it will be quite easy to add another layer of composite onto the gingival aspect of the pontic. (Figs. 10 and 11)

CONCLUSION

Although the use of fibre reinforced composites for this purpose is relatively new in South Africa, five year clinical results are very promising. (Vallitu 2004)[24] A substantial monetary saving is achieved by following the direct single-visit technique, eliminating the services of a dental laboratory. It is not necessary to prepare adjacent teeth, so the biological costs are low. In fact, it makes more sense to conserve as much as possible that part of the tooth which displays the best bonding surface in the oral cavity, i.e. the enamel of the tooth. Additionally, as this technique is reversible it allows other restorative options to be evaluated at a later time. These restorations offer a viable alternative to more expensive fixed or removable prostheses. On a social basis it provides fixed prosthetic dental treatment for those that could not previously be treated due to monetary considerations. It also blends in well with the concept of "value for money dentistry".

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