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Translucency of glass-fiber-reinforced root canal posts

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Introduction

The reconstruction of heavily damaged devital teeth can be a problem when the retention area of tooth is missing. In this case, the use of root canal posts can be helpful and allows the dentist to increase the amount of surfaces needed for retention. In today' s dentistry more and more glass-fibre reinforced retention pins are used in order to achieve higher esthetical results, especially in the area of front teeth. Glass-fibre reinforced root canal posts mainly consist of the connection of two materials: glass-fibre and composite. In order to minimize the difference between the expansion of technical and physiological material this new composite was developed to adjust the rate of elastic deformation (homo elasticity) to the functional structure of the recipient tissue (structural compatibility). In regard to the elastic modulus and hardness the glass-fibre carries the main load and therefore it shows higher results than the organic matrix. Furthermore, glass-fibres are able to transport light energy. This is important for the polymerization of light hardening composite in the root canal. The present results are dealing with the energy transmitted in dependence of the individual geometrical shape of the root canal posts.

Material and Methods

In the present study four different light-transmitting pins were used. They all consisted of parallel glass-fibres coated with polymeric matrix (Fig.1). Different geometrical forms were tested (Fig.2).

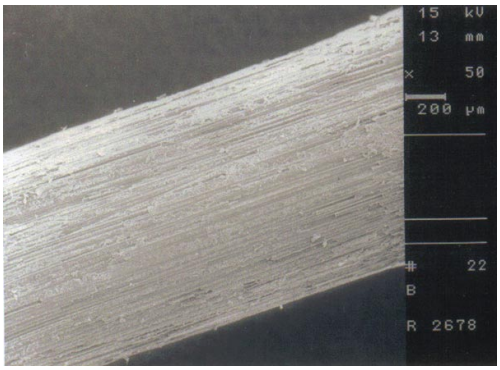

Fig.1: SEM-shot of the retention pin´s surface (Twin Luscent Anchors®)

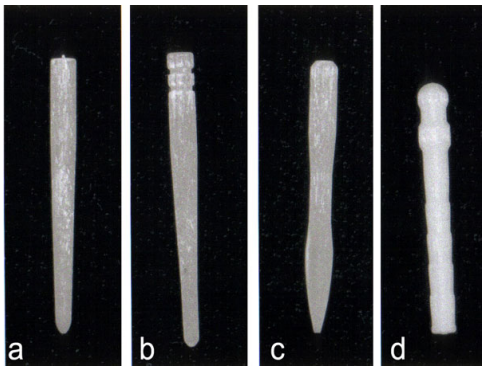

Fig. 2: Used light transmitting fibre-glass pins

a) FRC Postec®
b) DT Light Post®
c) Twin Luscent Anchors®
d) Para Post® FIBER WHITE

Two experiments were made to demonstrate the energy transmitted along the length of the fibre. In the first experiment, light transmission through the root canal posts was documented by photographs. The hardness (Knoop) of the polymerization in dependence of the light transferred through the pin was measured in a second experiment.

The transmission of light
The device used for the experiments is shown in (Fig.3). It was designed to demonstrate the ability of each pin to transmit light. Pictures were taken of three pins in a darkroom. The pins were illuminated with blue light, wavelength 400-470 nm.

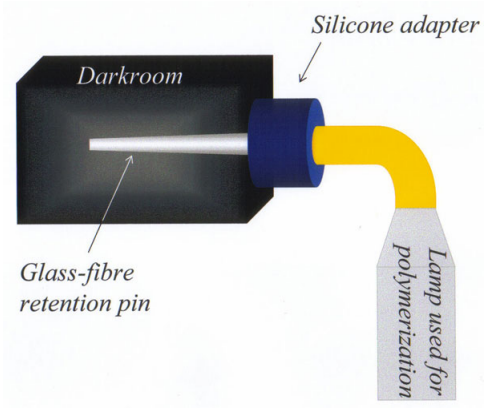

Fig. 3: Diagram of the device for the demonstration of light transmitted. Pictures were taken with the camera Nikon D1x , lens Micro-NIKKOR 105mm

Verification of hardness

The hardness of the composite material around the pin indicates the amount of transmitted light. In order to evaluate the hardness of the composit, the pins were polymerized in a special device (Fig.4). Afterwards sections were made (Fig.5).

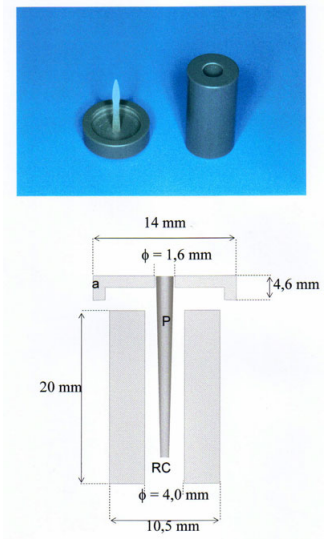

Fig. 4: Diagram of the device made for the simulation of the root canal

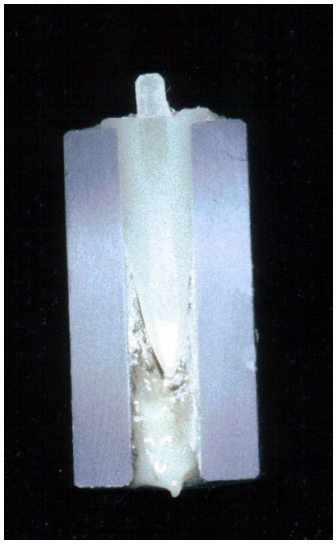

Fig. 5: Prepared section ready to determine the composite´s Knoop-hardness.

The Knoop-hardness could be calculated by measuring the length of the impressions along the pin in exactly defined intervals (Fig.6). The examination was performed with the following pins: FRC Prostec® and Twin Luscent Anchors®. For each pin twenty specimen were produced, of which five in each case were illuminated for sixty, eighty, hundred and a hundred and twenty seconds. Ten repetitions were made. The data for the reference values were gained by hardening composite cement in the described way. To evaluate the hardness, it was treated in the same manner as the sections of the pins afterwards.

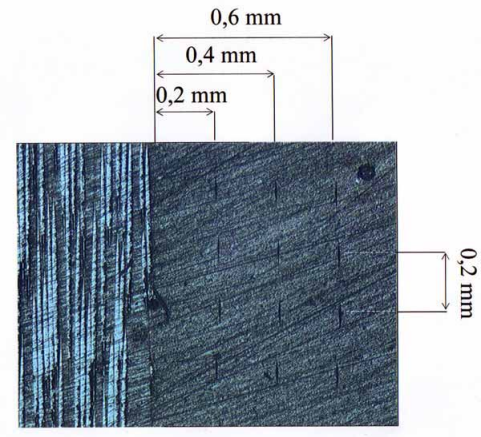

Fig. 6: Section with impressions photographed after testing the Knoop-hardness. (Original enlargement 12,5:1)

Results

Especially the upper third showed a high ability of transmitting light. But in regard to the cloud of light, different dimensions were observed for each pin. The highest loss of intensity was found with the Para Post® FIBER WITHE resulting in a total lack of light emission in the two apical thirds. This indicates the use of a binary hardening cement. The other two retention pins did not range too greatly in reliance to the loss of light intensity. Moreover the Twin Luscent Anchors® shows a different distribution of the light cloud because of its' complicated geometrical form (Fig.7). Light energy is used to induce the polymerization of dental cement. Increasing the period of exposure terminates in a higher rate of polymerization. This again is crucial for the final hardness. Cement nearest the source of light shows greater hardness. Depending on the individual design of each pin the remaining lightintensity reaches different parts surrounding it. The graph of the FRC Postec® and Twin Luscent Anchors® were devided into two sections: the first showing an equal amplification in the apical region. The observation of the second section of the FRC Postec® displays a diminution with increasing time of exposure. An intensification of the depth of the polymerization can therefore not be achieved. On the contrary the second section of the Twin Luscent Anchors® reveals an elongation with an enhanced time of exhibition causal to the specific configuration, especially the parallel and beadlike shape. They cause the light energy to remain within the fibre and create an equal transmission along the pin. All in all the Twin Luscent Anchors® shows more satisfactory results in regard to final hardness than the FRC Postec®. Furthermore a full intensity of light exposure left the composite in the apical region of the FRC Postec® unpolymerized.

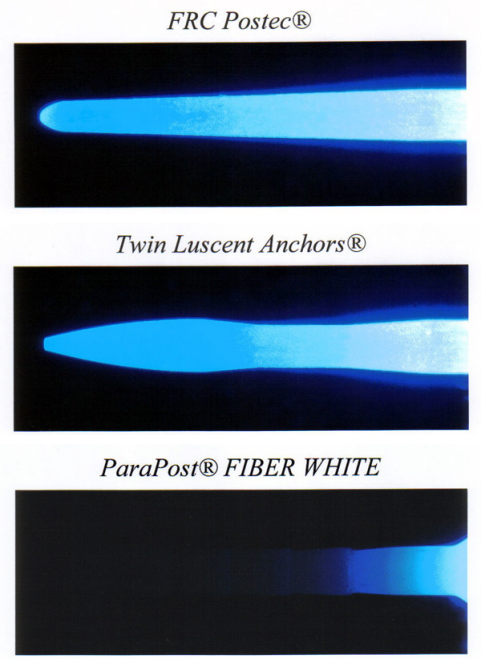

Fig. 7: Photographs taken of the light transmitted and the light cloud.

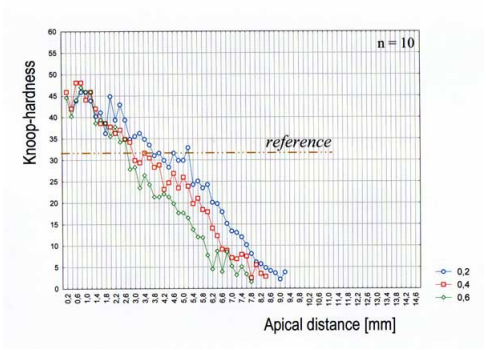

Fig. 8: Hardness of composite dental cement (FRC Postec® after 60 sec of illumination)

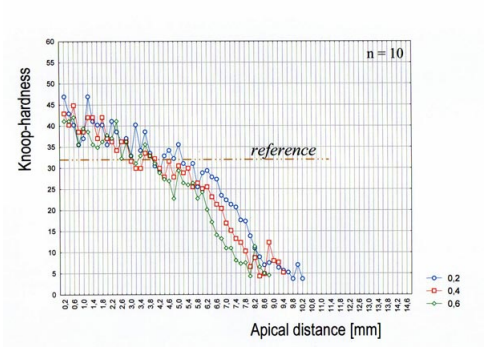

Fig. 9: Hardness of composite dental cement (FRC Postec® after 80 sec of illumination

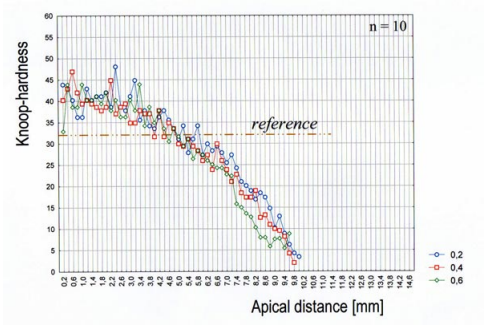

Fig. 10: Hardness of composite dental cement (FRC Postec® after 100 sec of illumination)

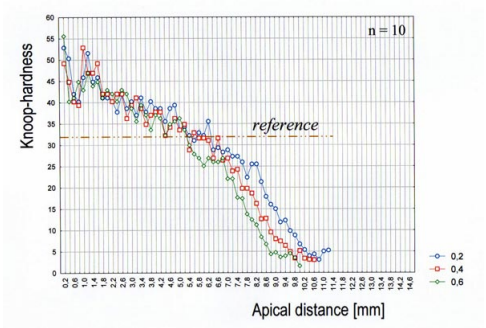

Fig. 11: Hardness of composite dental cement (FRC Postec® after 120 sec of illumination

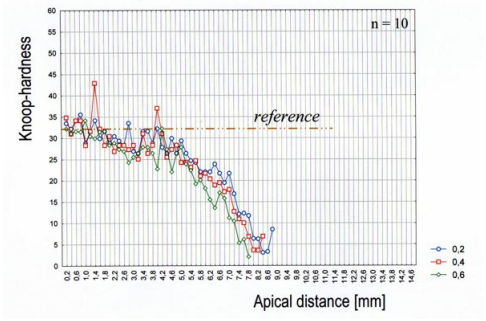

Fig. 12: Hardness of composite dental cement (Twin Luscent Anchors® after 60 sec of illumination

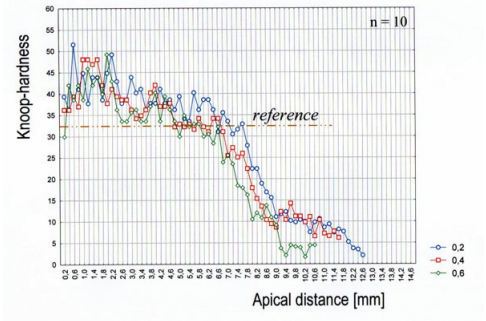

Fig. 13: Hardness of composite dental cement (Twin Luscent Anchors® after 80 sec of illumination)

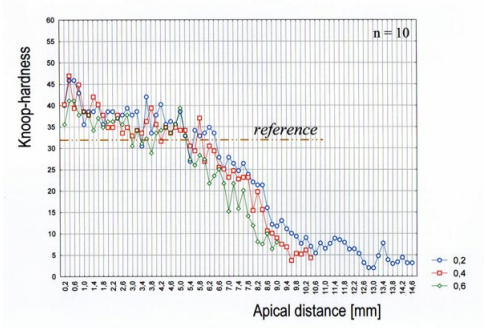

Fig. 14: Hardness of composite dental cement (Twin Luscent Anchors® after 100 sec of illumination

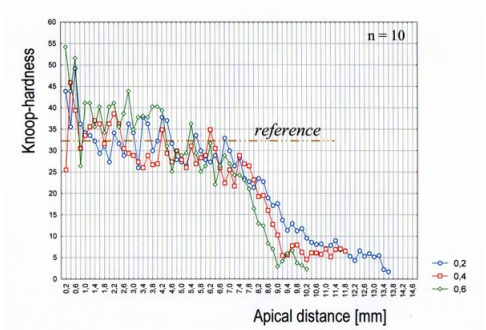

Fig. 15: Hardness of composite dental cement (Twin Luscent Anchors® after 120 sec of illumination)

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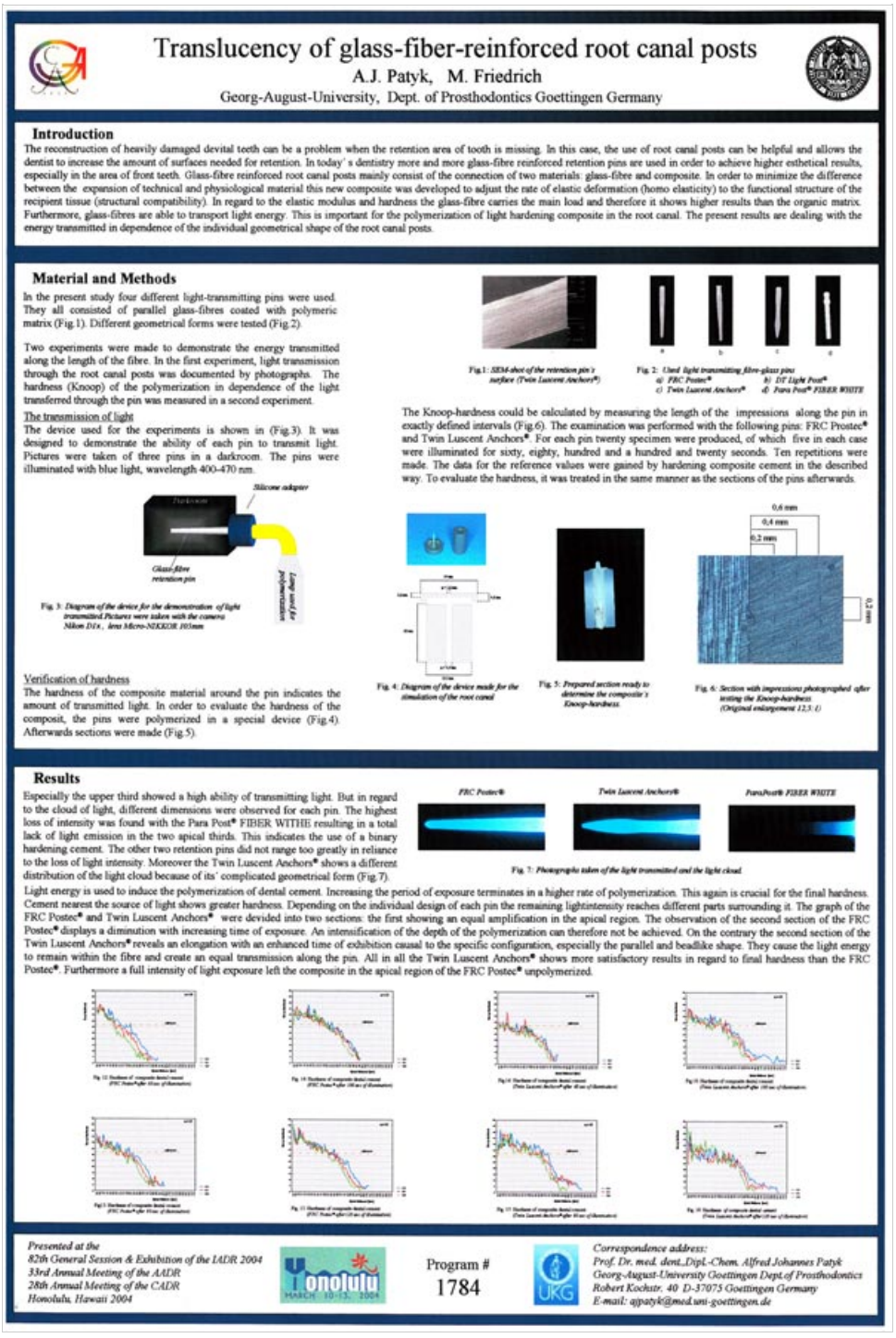

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FRC Postec® Twin Luscent Anchors® ParaPost® FIBER WHITE

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