CHAPTER 3

B. DISCUSSION
DISCUSSION

With the advancements in the field of endodontics, teeth which are involved pulpally and were formerly considered for extraction can now be retained. Root canal therapy alters physical characteristics of the tooth due to which all teeth need some form of restorative treatment. As Amalgam, Glass Ionomer Cement (GIC), Modified GIC and Composite Resin have been used as core materials in the past. Completely cured composite resin cores are said to have better than prepared cores of GIC and Amalgam. [43]

Composite resin cores have been used widely because of their good adhesive properties, low modulus of elasticity, their affordability in terms of cost and most important their high compressive strength. Besides that, they are tooth colored and do not make the teeth dark. Core build up on tooth can be completed using rotary instruments easily because they set quickly. [5]

There are a number of composite resin based core materials available today out of which four materials were selected which are used widely by clinicians these days, namely Para Core, Luxacore Z Dual, Fluoro Core and MultiCore.

Build up of a core is obligatory as when the bulk of residual tooth substance is less, the buildup increases the retention and resistance provided by the remaining tooth structure. Morgano and Brackett [18,44,45,46,47,48,49,50,51,52,53] gave a detailed account of some utilitarian features of a core material. These properties comprise the following: “enough compressive strength and flexural strength to resist intraoral forces during mastication, compatibility with oral environment, resistance to leakage in oral fluids at the core to tooth interface, ease of manipulation, ability to bond to remaining tooth structure, thermal coefficient of expansion and contraction similar to that of tooth structure, dimensional stability, very minimal potential for water absorption and curbing dental caries”.

The compressive strength was tested using stainless steel cylindrical mould of 6mm length and 4 mm internal diameter to make standardized specimens. Antara Agarwal et al [18] in their study also used these dimensions for preparation of the samples. Colotux 2.5 curing light of 400 Mw/cm² intensity was used for 40 seconds. Kramer et al [54] in his study postulated that all the core build up materials be subjected to polymerization for 40 seconds with the help of light curing unit.
The constitution of a material plays a vital role in its mechanical properties. According to M.A Rafiee \[55\] “increasing the volume fraction of filler particles in composite resin would heighten the probability of fracture because the crack needs less energy in the less dense microstructure. Hence, minimal particle size leads to higher strength”.

Substantial differences in compressive strengths were distinguished among the four materials. The strongest material was Para Core and the differences in compressive strength of each group were statistically significant indicating clinical significance as well. Para Core is a fiber reinforced resin and shows excellent strength because of the macroscopic size of the fiber bundles which are unidirectional. The presence of fibers has shown to have an effect on fracture process thus resulting in interruption of crack growths. Thus it enhances the fracture toughness of the fiber reinforced composite material. Being a dual cure material it ensures complete cure and thus improves the mechanical properties of the material. \[56\]

If the tensile strength is determined by direct application of the tensile load during testing and external stress is generated by gripping the samples, the results may incorporate errors which are unacceptable. In order to overcome this problem, dumb –bell shape specimens should be used and a diametral compression test should be done. In accordance to study by Sheila Passos et al \[11\], dumb bell shaped specimens were used in the study. The specimen is submitted to a compressive load in the diametral plane. The load is kept perpendicular to the longitudinal axis in this type of testing. \[5\] It was originated to probe brittle materials having little or no plastic deformation. It is the most popular method for measuring tensile strength because it avoids some of the problems which exist in direct and flexural tensile testing methods. \[15\] The diametral tensile strength test may give different values for materials which seem apparently similar. This variation in values can be explained by the bond between fillers and matrix and the difference between the polymer matrix and size of fillers. \[57\]

A cross head speed of 0.5mm/min was maintained to determine the flexural strength. This was done in accordance with the study by Umesh Et al \[20\] Flexural Strength is also known as “transverse strength or modulus of rupture. Essentially it is a toughness test of a bar supported at each end, or thin disk supported along a lower support circle, under static load”. \[11\] The three-point bending flexural test gives values for modulus of elasticity in bending, flexural stress, flexural strain and the flexural stress–strain response of the material. The major benefit of a
three-point flexural test is the effortless preparation of the specimen and uncomplicated testing. As flexural strength reflects resistance to compressive and tensile stresses that act in the material simultaneously, the assessment of this property is essential for core build-up materials. Luxacore Z dual shows excellent flexural strength which can be attributed to the nanoparticles used in it. Particle agglomeration is eliminated by incorporating a proprietary coating process during manufacture. Luxacore Z Dual possesses flexibility, insulation and most important strength which is similar to that of dentin, as stated by manufacturers. Different kinds of fillers in Luxacore such as aluminosilicate glass, fumed silica and titanium oxide, which could be the reason for their high strength.

Maxillary Anterior teeth in humans are prone to injury during accidents and receive most of the angular forces. These teeth were hence selected as the best possible option to mimic the clinical situation. With regard to morphology of the tooth, the palatal concavity and the incisal areas of maxillary anterior teeth are considered to be highly stressed during function. In pediatric patients, maxillary anterior teeth are prone to nursing bottles caries.

The practice of endodontic therapy (better known as root canal therapy) involves an access cavity preparation. This gives endodontic instruments “straight line” entry or access into the canal. This, along with the theory of “crown down technique” in root canal therapy indicates that sounder dentin should be removed for cleaning and shaping of root canal efficiently. Crown Down technique was hence used in root canal treatment of each tooth.

According to previous studies, root canal treated teeth and their vital counterparts exhibited similar biomechanical properties. These properties were strength, load and toughness required for fracture. Also, reports suggest that root canal treatment does not increase tooth fragility and dehydration after endodontic treatment does not weaken the dentinal structure in terms of compressive or tensile strength.

In this study, glass fibre posts (prefabricated) were used and core build up was done using ParaCore, Luxacore Z Dual, Fluoro Core and Multi Core composite materials. “In endodontic treatment of fractured anterior teeth, restoration with prefabricated posts and composite resin is a viable technique” (Jordan, 1987).
When the prefabricated post and composite resin is used, the commonest cause of failure is the fracture of the restorative material. Fracture Resistance is one of the main characteristics of restoration materials, especially during chewing and biting and the most important factor in achieving a long lasting restoration.

Fiber reinforced post restorations were able to restore the mechanical properties in maxillary incisors treated with endodontic treatment. Hence glass fibre posts were used in the study.

Resin luting agents can be used to bond posts to the sound tooth structure. Numerous studies have suggested enables the formation where tooth, the post in it, the core and the crown serve as a single cohesive unit. The conceptualization is known as monoblock configuration. The fracture resistance of the restored root canal treated tooth is the fracture of the root or remaining coronal tooth structure and the post or core and the bond strength among them.

Glass fibre reinforced posts have more flexible fibres as compared to carbon fibre posts which have stiff fibres. They are regarded more flexible than metal posts also. This has been regarded as an advantage by some authors and a disadvantage by others.

Material property of the post affects the distribution of stress. It is more favourable when two materials of same or nearly same modulus of elasticity come in contact. Considering modulus of elasticity for dentin that is “20,000 Mpa”, the glass fibre post having “54000 Mpa” modulus of elasticity would be a more favourable post in terms of stress distribution in comparison to others such as stainless steel with a modulus of elasticity “220,000 Mpa”.

When stress is applied to the post system, a rigid post (possessing high modulus of elasticity) does not undergo elastic deformation but it generates localized stress peak inside the root, which leads to fracture. Hence we can reach a conclusion that the fiber post has features imitating real dentin. It acts like an absorber of shock, dissipates stresses on the finished restoration with small forces to dentinal walls, as a result clearly showing fractures which are restorable. Composite core have the best adaptation and form strong bond to tooth structure that is remaining, bonds to posts and resin cements easily and ultimately the final restoration creating a “monoblock”.

Another positive factor is that it is esthetic (translucent) as opposed to a metallic or dark post that will have a “Shine through” effect from the core. The introduction of glass fiber posts and
composite resin has brought forward a new concept of esthetics which is termed as “Endoesthetics”. [65, 66, 67, 68]

Glass fiber posts are cylindrical in shape. A study by Sorenson & Martinoff in 1984 [69] concluded that 97.7% clinical success can be obtained by using a cylindrical prefabricated post. With the presence of an appropriate ferrule and normal functioning for a single anterior esthetic crown, glass fiber posts provide best results”. [69]

A ferrule is “defined as a metal band or ring used to fit around the root or crown of a tooth”. It is highly required along with posts. [70]

In the present study, the compressive strength testing was done with the help of Universal Testing Machine at cross head speed of 0.5mm/minute. This method was in accordance to the study done by Gulbin [71] who advocated the use of Universal Testing machine to determine the mechanical properties of core materials. In the present study, the tensile strength was evaluated at cross head speed of 1 mm/minute on the Universal Testing Machine. This method was used in the study done by Alvaro Della Bona et al [72] who advocated the same speed on Universal Testing machine to evaluate the tensile strength of core building materials.

As manufacturer’s information regarding the tested materials is not conclusive, further research will be helpful to establish these core build-up materials as an ideal one imparting good strength along with good clinical success.