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Tightness of two coronal obturation techniques: Comparative study

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Abstract: The purpose of this study is to evaluate the tightness of four composites: Bulk fill, hybrid, microhybrid, nanohybrid composite, and to compare the bulkfilling technique with the oblique obturation technique.

Materials and methods: 120 proximal cavities (4 × 4 mm) were performed on 60 molars. The cavities were randomly assigned to 4 experimental groups (n = 30).

Group 1: monoblock obturation technique with Bulk fill composite

Group 2: oblique obturation using the hybrid composite

Group 3: oblique obturation using the microhybrid composite

Group 4: oblique obturation using the nanohybrid composite.

After the cavities were filled, the specimens were immersed in a 1% methylene blue solution for 18 hours and then rinsed with running water. The teeth were cut longitudinally, removing the buccal face of the tooth The tooth-composite joint was photographed using a digital SLR camera The statistical analysis of the results was done by the software Epi info 6.0.

Results: Group 1 has an average infiltration of 0.900 mm lower than group 2 and group 3, Group 1 has an average infiltration of 0.900 mm superior than group 4.

Conclusion: Filling using the bulkfill composite is more efficient than the oblique obturation using the hybrid composite. The oblique obturation using the microhybrid and nanohybrid composites showed a similar tightness than the composite Bulk fill.

Conflict of interest: The author(s) declare(s) that there is no conflict of interest regarding this experimental study.

Introduction:

Composite resins are used in the daily practice, according to the concept founded by Bowen (1) the composite resin is constituted by an organic matrix coupled to fillers using a coupling agent (silane).

These three constituents give

the composite specific technical characteristics: high hardness, Chemical inertness, refractive index close to that of resinous matrices, opacity. a remarkable evolution in composite resins has revitalized the conservative part of the durability, biocompatibility and sealing of coronary restorations (2,3).

Our experimental study will focus on a new generation of composite "bulkfill". which permit the insertion of larger quantities of resins and a shorter photopolymerization time. The use of the bulk takes less time and the “window of opportunity” for technical errors, such as void incorporation and contamination between layers, can be decreased. (4) The purpose of this experimental study is to evaluate the tightness of four composites: Bulk fill, hybrid, microhybrid, nanohybrid composite, and to compare the bulkfilling technique with the oblique obturation technique.

Materials and methods:

Sixty molars were collected and conserved in physiological serum solution.

Inclusion criterias:

- Wisdom teeth with mature apex
- Lower mature molars (46/47/36/37)
- Healthy Teeth extracted after a periodontal disease, without any decay,

fracture or crack.

Molars were selected because of their important coronal height and shallow

grooves so the cavities realized don’t reach the pulp.

Exclusion criterias:

- Upper molars;
- Decayed or fractured teeth;
- Teeth extracted for more than four months.

The teeth roots were included in a resin base to make the preparation and the obturation steps easier for the operator. (Fig 1 & 2).

Figure 1: sixty teeth bonded by their occlusal surfaces on a glass plate

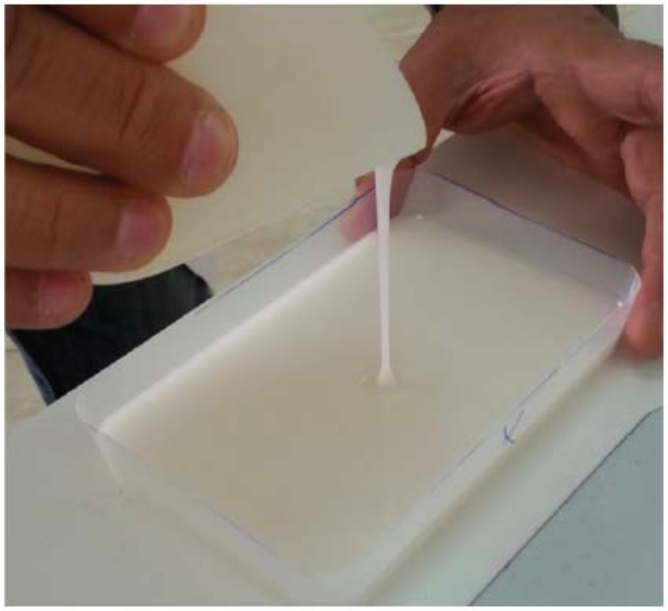

Figure 2: preparation of the resin material before the inclusion of the teeth in it

120 proximal cavities 4mm depth and 4mm height were performed in mesial and distal of each sixty molars by a single experimented operator, using a milling machine (F4 basic, DEGUDENT). (Fig 3, 4).

Figure 3: cavities realization using a milling machine (F4 basic, DEGUDENT)

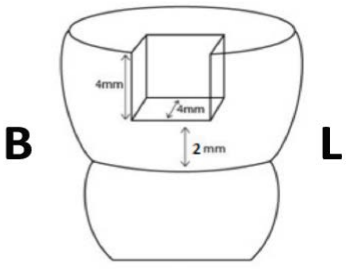

Figure 4 : illustration of the cavity architecture and dimensions

The cavities were randomly assigned to 4 experimental groups (n = 30).

Group 1: one-step obturation technique with Bulk fill composite (Tetric Evo Ceram Bulk Fill) (Fig 5)

- Application of Phosphorique acid during 30 seconds
- Abundant rinsing with running water during 30 seconds
- Gentle drying of the cavity with air jet
- Application of the adhesive system Tetric N Bond TE®
- Lightcuring using bluephase20i lamp (Ivoclar, Vivadent) during 10 seconds
- Setting of matrix system Automatrix®, Dentsply.
- One-step obturation the cavities with 4mm of bulk fill composite
- Lightcuring using the "soft start" mode during 40 seconds.

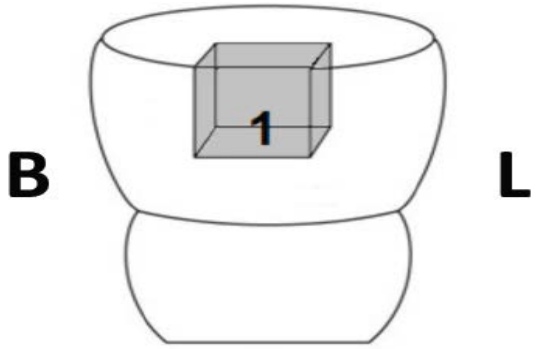

Figure 5: Illustration for one-step filling using the bulk fill material for the following groups, the same protocol was followed and each composite were used with its proper etching and adhesive system. (Table 1)

Table 1: Etching and adhesive systems used for group 2, 3 & 4.

	Etching	Adhesives
Hybrid 3M ESPE, Valux® plus	**Scotchbond Etchant**	**Adhesive Adper Single Bond 2**
Microhybrid OKTAFILL LC®, Oktan	**OKTAETCH**	**OKTABOND**
Nanohybrid OKTAFILL ®		

Group 2: oblique obturation using hybrid composite (3M ESPE, VALUX PLUS)

Group 3: oblique obturation using microhybrid composite (OKTAFILL LC OKTAN)

Group 4: oblique obturation using nanohybrid composite (OKTAFILL OKTAN).

- Cavity etching during 30 seconds,
- Abundant rinsing with running water during 30 seconds,
- Gentle drying of the cavity with air jet,
- Application of the adhesive system,
- Lightcuring using bluephase20i lamp (Ivoclar, Vivadent) during 10 seconds
- Setting of matrix system Automatrix®, Dentsply.
- Oblique obturation of the cavities with tree composite supply: the first supply to build the proximal wall, the second to build the lingual cuspid and the third to build the buccal cuspid. (Fig 6 & 7).
- Lightcuring using the "high power" mode during 5 seconds after each supply of composite.
- A final 40 seconds lightcuring at the end of the obturation using the "soft start" mode.

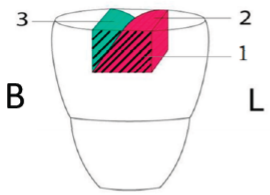

Figure 6: illustration of the obturation with the incremental technique

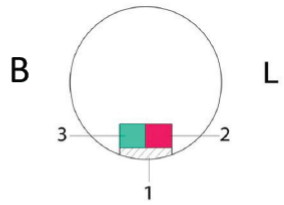

Figure 7 : occlusal view of the obturation with the incremental technique

1: first increment (proximal wall) 2: lingual increment 3: Buccal increment

The specimens were immersed in a 1% methylene blue solution for 18 hours and then rinsed with running water.

The teeth were cut longitudinally, removing the buccal face of the tooth. The tooth-composite joint was photographed using a digital SLR camera Nikon D90.

The quantification of the infiltration using Kodak dental imaging software 6.12.10.0. measures were in millimeters

(mm) by drawing a line going from the proximal limit of the cervical joint at the end of the infiltration.

Data Analysis

The statistical analysis of the results was done using Epi info 6.0 software.

Results

Group 1: The analysis of the thirty cavities revealed an infiltration average of 0.900 mm with a standard deviation of 0.908

Group 2: The analysis of the thirty cavities revealed an infiltration average of 1.448mm with a standard deviation of 0.875

Group 3: The analysis of the thirty cavities revealed an infiltration average of 1.268 mm with a standard deviation of 0.945

Group 4: The analysis of the thirty cavities revealed an infiltration average of 0.477 mm with a standard deviation of 0.600

Table 2: Calculation of averages, variances and standard deviation of the penetration depths of the dye in the 4 groups.

	Average (mm)	Variance	Standard deviation
Grp 1	0,900	0,824	0,908
Grp 2	1,448	0,766	0,875
Gp 3	1,268	0,893	0,945
Grp 4	0,477	0,360	0,600

The averages, variances and standard deviations of the dye penetration were calculated (Tab 2).

A comparison between the first group and the other groups were realized to determine the infiltration degree between the one-step technique and the oblique obturation technique.

The degree of significance of the differences obtained after the comparisons between the two groups were measured using a non-parametric statistical test: Fisher test; the difference was considered significant if $p<0.05$. (Tab 3)

Table 3: Calculation of averages, variances and standard deviation of the penetration depths of the dye in the 4 groups.

	Sample variance	Residual variance	Standard deviation
Grp 1/Grp 2	4,2	0,79	0,025082
Grp 1/Grp 3	1,86	0,86	0,146535
Grp 1/Grp 4	0,00	-	0,159132

Group 1; one step obturation using Tetric EvoCeram® Bulk Fill (Ivoclar, Vivadent) showed an average of infiltration lower than Group 2; oblique obturation technique with hybrid composite (3M ESPE, Valux® plus), this difference was statistically significant.

Group 1; one step obturation using Tetric EvoCeram® Bulk Fill (Ivoclar, Vivadent) showed an average of infiltration lower than Group 3; oblique obturation technique with microhybrid composite (OKTAFILL LC®, Oktan), but the difference was statically non-significant.

Group 1; one step obturation using Tetric EvoCeram® Bulk Fill (Ivoclar, Vivadent) showed an average of infiltration higher than Group 4; oblique obturation technique with nanohybrid composite (OKTAFILL LC®, Oktan), but this difference was statically non-significant.

Discussion

Sixty Freshly extracted teeth (molars) were kept in physiological serum solution to maintain the hydrodynamic properties of a natural tooth. The cavities were 4mm deep and 4mm height, and 2mm far from the enamel junction to prevent infiltration through cement or bare dentin.

The preparation was standardized using a resin calibrated base which enable us to realize cavities with similar 4mm depth using a dental milling machine

manipulated by a single experimented operator. The lightcuring was realized using a bluephase curing light following two curing modes “high power” and “soft start”, Amaral & coll found that there is no statistically significant difference between five curing modes. But Zakavi F. and coll (5, 6) have found a significant difference between LED lamps and Halogen Light Curing Unit showing more efficiency for LED lightcuring lamps. (7, 8).

All the specimens were immersed in the blue methylene solution; the process of capillarity is very important to control the tightness of the coronal filling since the marker seep under the filling material. In fact, the molecular weight of methylene blue is less important than bacterial toxins. (9, 10, 11, 12) Many evaluation techniques have been described in the literature but this

manoeuver remain simple, cheap, fast, not requiring a specific material and doesn’t depend on a chemical reaction or irradiation. Many studies have used this technique by 1% methylene blue solution or 5% basic fuchsine dye (3, 9, 13) We can access the zone infiltrated by the colorant directly with a longitudinal section of the teeth, then measuring the infiltration using imagery tools. Many studies have compared the hybrid composite to the bulk Fill and foundresults comparable to our experimental study.

Bulk Fill / microhybrid composite

This study has evaluated the retraction during the polymerization of five

composites, they found that the bulk fill composite has shown better results

comparing to microhybrid composite (Filtek Z250) with a statically significant difference between the two groups of the study, this may support the indication

of the bulk fill in case of deep cavities with a high C-factor. (14)

Bulk fill / nanohybrid composite

A study about the marginal adaptation in the Class II cavities filled with Bulk Fill composite have compared four composites and it was statically non-significant difference between bulk Fill composite and nanohybrid composite (Ceram-X® Duo – Dentsply) (12)

FILTEK Bulk FILL flowable composite / SUREFILL SDR Bulk Fill flowable composite

Sure fill flowable showed better results regarding the depth of cure and degree of conversion compared to filltek bulk fill composites the degree of conversion, defined as the percentage of reacted aliphatic C=C bonds from the dimethacrylate monomers present in their polymeric matrices (17, 18, 19).

Conclusion

Tertic EvoCeram® Bulk fill (Ivoclar, Vivadent) showed a superior seal compared to the hybrid composite (3M ESPE, Valux® plus), which was not the case for the microhybrid composite (OKTAFILL LC®, Oktan) and similar tightness was noticed to the nanohybride (OKTAFILL®, OKtan). In spite of the diversity of results, Bulkfill with its one-step filling technique has open new fields in coronary restorations, in terms its simple use and time saving, but its high translucency can affect aesthetics results (Frankenberger & al. 2012).

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