


Differences in Compressive Strength of Hybrid Composites and NanoHybrid Post-Curing Composites Using Dry Heat

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Article Info	ABSTRACT
<p>Keywords: Nanohybrid composite, Hybrid composite, Compressive strenght</p>	<p>Posterior restoration that using composite with indirect tehniqe has been widely used by dentist. The variations of the composite fillers has given differ compressive strenght, flexibility, and durability. The aim of this research is to study the compressive strength between hybrid composite and nanohybrid composite using the dry heat post curing. The research represent a apparent experimental, with samples divided into two groups of each 20 specimens of nanohybrid composite and hybrid composite. All of specimens are polmerised by LED (Light Emitting Diode) curing light for 20 seconds, and post polimerisation with dry sterilisator for 10 minutes at 1100C, excepted a control group. A test was then performed by LRX Plus Llod Instrument at 1 mm/minute speed. The result is showed that compressive strength of nanohybrid composite value 192,52 mpa more than hybrid composite which value 156,65 mpa. Analyse t-test statistic presented unsignificat result. It was summarized that there are no significat different between nanohybrid composite and hybrid composite post cured with dry sterilisation.</p>
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INTRODUCTION

Restoration posterior teeth using composite resin has become choice practice doctor teeth. Composite resin give results end good restoration, fulfilling criteria adequate aesthetics as well as strength and endurance that can accountable. Composite resin can used Good For anterior and posterior teeth. 1

Connection between tooth must maintained in action restoration tooth so that function and aesthetics still fulfilled. 2 For fulfil conditions earlier, technique restoration indirect can made into alternative. Technique restoration indirect is restoration preparation material restoration done outside mouth with replicate results preparation tooth For Then attached using cement on teeth that have been prepared. 3,4

Technique restoration indirect using composite resin is alternative For restoration wide posterior teeth, so that function tooth teeth can back to normal. 3 With technique indirect, composite resin used as inlay / onlay polymerized outside mouth For Then attached to the prepared tooth.

Composite resin polymerization process will Keep going continue although source ray Already no 5, polymerization declared ideal moment all monomers are polymerized perfect. In technique indirect process polymerization of composite resin to be continued with the heating that will perfect unification composite resin matrix with increase monomer conversion so that composite more strength and homogeneity make color more stable. 6 Technique warmup can increase adhesion resin matrix and *filler* so that can increase characteristic mechanical composite that is strength pull and press on restoration composite indirect. 7

Various type composite moment This circulating in the market, some factory besides produce composite for indirect also produces tool special *post curing* for inlay/ onlay. Restorative materials composite For direct in practice made for technique indirect, the process of making inlays / onlays No use tool specifically for *post curing* this process used tool sterilizer dry. Heating with sterilizer dry as *post curing* composite give more violence Good compared to without *post curing*. 8

Study use type composite *hybrid* shows violence composite *post curing* warmup dry more Good when compared to with those who don't *post curing* 8, research the need to be continued with compare type different composites. In the market moment this, known various type composite, composite *nanohybrid* is said Good For restoration anterior and posterior teeth as well excel in results more polishing smooth. While composite more *hybrid* recommended For tooth posterior, type *hybrid* characteristic the mechanics Good Because existence *macrofiller* ($> 1 \mu\text{m}$). 9 Based on things the on writer want to do study For see difference strength press between composite *hybrid* with composite *nanohybrid post-curing* use warmup dry.

Framework Thinking

Character composite resin material in withhold Power chewing, abrasion, and adaptation to wall cavity rated good. 9 Currently with range increasingly colorful wide as well as variants increasingly popular products many, composite resin is choice For restoration posterior teeth. Success restoration use composite one of them obtained with polymerization adequate composite. Quality material restoration can known with measure property physical, property mechanics and efficiency polymerization during the curing process.

In technique indirect, resin composite applied as material restoration tooth after the manipulation process composite on *die* includes formation and polymerization finished. Polymerization of composite resin in the technique indirect using units *light curing* for 20 seconds and will more maximum the result If followed with heating of polymerized composite resin. 13 In market Lots offered tool heater used For polymerization of composite resins as referred to by the manufacturer as *oven*. *Post curing* in manufacturing composite indirect can perfect polymerization For increase characteristic mechanical from material composite on strength press. *Post curing* can done with use *oven* or heating that works produce hot For make polymerization matrix composite resin become perfect after polymerization use *light cure unit*.

In the polymerization process composite, occurs conversion bond carbon double become bond carbon single and known as related degree of *conversion* with level violence.

Degree of conversion used For know degrees polymerization. The more tall *degree of conversion*, increasingly tall strength and resistance composite to chewing power. 12 Quality material restoration can known with measure property physical, property mechanics and efficiency polymerization during the curing process. 16

Study in a way *in vitro* by Wendt (1994), showed that warmup composite after *curing* with ray add characteristic mechanical composite, stated that 5 minutes heating at 123 0 C post *curing* increase hardness and *wear resistance* up to 70%. 27

Composite materials *hybrid* is material combination from particles material composite resin filler *macrofilled* and *microfilled*, fillers *hybrid* consists on silica colloidal silica functioning For increase composite resin volume percentage so that fill in content material filler amounting to 75-80% of the total volume of composite resin so that Lots used For restoration posterior teeth. 6

Development nanotechnology produces nanocomposite with particle *filler* nano size that can increase properties physical and mechanical from composite resin. 10,11 Filling material composite *nanohybrid* shaped particle nanomeric and *nanocluster*. Composite resin *nanohybrid* own characteristic more physical and aesthetic good, have strength and endurance to wear and tear as well as a longer service life so can used For restoration posterior teeth. 6

Analysis mechanical composite with nano *filler* shows *compressive* and *diametral strength* as well trachial *resistant* his equivalent even more high compared to other types composite other than that, it also produces more surface fine so that more easy to polish. 12

Composite Resin Polymerization

Polymerization is reaction the chemistry that occurs when resin molecules with heavy molecule small units called monomers join together form chain long, with heavy molecule more the big one called polymer. Bond cross between polymer produce more material strong and stiff compared to polymer with single chain. 5,21

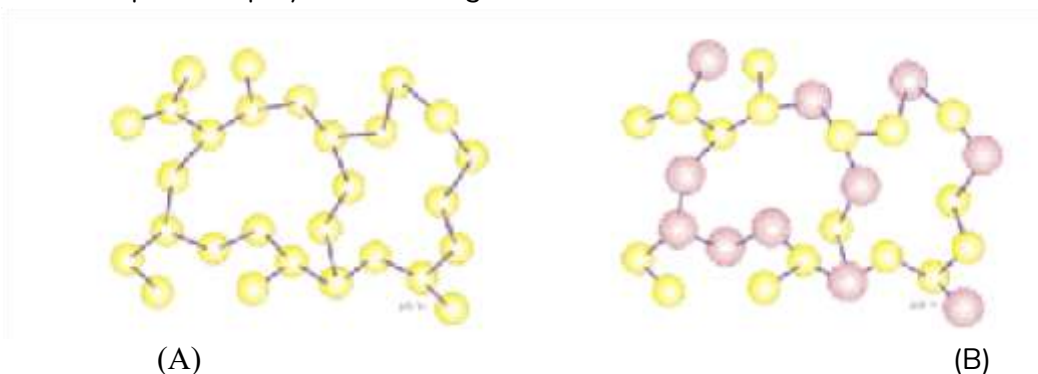


Figure 2.3. Bonding cross polymer. (A) monomer with carbon double, between polymer each other bound, so that more strong (HF Albers, 2002)

Resin activation composite can happen in a way chemistry and activation use source rays, and a number of types that can applied as core or patch temporary activated in a way chemistry as well as rays (*dual cure*). 22

Activation Chemically

Reaction active composite resin polymerization in a way in a way chemistry with mix two components, the *base* being *organic peroxide* as initiator and catalyst in the form of tertiary amine as activator. Second part This stirred simultaneously at temperature room until formed radical free as polymerization trigger. 22,23

The operator has time that limited For put restoration before the pasta become too rigid For manipulated. Because both pastes must be stirred manually, air can influence the material, causing porosity in restorations. Many clinical more choose *light cure* Because No need composition stirring and the operator can control *working time* with decide When apply source ray.

Activation Use Light Source

Composite resin *light cured* is common types of composite resin used in practice personal. Intensity ray visible on the waves ray blue activate this material. Blue light with long wave between 400 and 500 nm activates diketone, with existence organic amine, causing the resin to polymerize. Components This both of them There is in composite and not react until ray start reaction. If the composite resin placed too thick, this No will polymerized perfect. Depth polymerization depending on location and color. Interproximal area Possible need time addition For polymerized perfect Because more access difficult. More colors darkness also needs more time long Because its light more easy absorbed by color dark and not continued through the material as easy as through colored materials brighter. 24

System activation use ray first formulated For ultraviolet (UV) rays form radical free. Nowadays, composites are used *curing* UV rays have replaced with system activation ray looks blue that has repaired depth *curing* and working period.

Dual Cure

Composite resin *dual cure* is two pastas consisting of from initiator and activator, polymerization happen Because activation with light and a little material with activation chemistry. The advantages is both pastes are mixed together and placed on the teeth, the light *curing* used For start reaction *settings* and reactions *settings* in a way chemistry continue in areas that are not accessible to light, to ensure perfect *setting*. 23

Restoration Composite Indirect

Technique restoration indirect, preparation material restoration done outside mouth with replicate preparation teeth, then attached using resin cement on teeth that have been prepared. 3,4

Restoration indirect indicated for : 3

1. Large cavity, and will difficult If his manipulation done directly in the cavity mouth.
2. Teeth strength reduce as well as at risk of fracture, for example post maintenance channel roots.
3. Previous restoration rupture and structure tooth weak.

Technique indirect composite start introduced late 1980s in Switzerland and later France known as an inlay composite. At that time used type *microfil*, next developed 1990 use composite *microhybrid* Which concentration *filler* is 60%. 25 On restoration composite

indirect done polymerization additional (*post curing*) with method increase degrees conversion so that expected will increase properties mechanical composite as restoration materials. 8

Research that compares strength mechanical a number of type composite show resin composite for application direct various *hybrid* own *compressive* good *strength* compared to a number of brand composite For indirect. Composite direct show strength good mechanics moment done addition polymerization. 25

Study

Type of research used in study This is experimental pseudo For research strength press on 2 types different composites, *hybrid* and *nanohybrid postcuring* with warmup dry. Population study This are 2 different types of composite resin, namely type *hybrid* and types *nanohybrids* on the market. Composite resin used is type *hybrid* and types *nanohybrid* with the same brand, produced from One factory. Selected composites is the one sold on the market as well as easy obtained in Indonesia.

Samples used in study This is:

Twenty (20) pieces composite resin specimen type *nanohybrid* and twenty (20) pieces composite resin specimen type *hybrid*, all of which shaped cylinder with a diameter of 3 mm, a height of 6 mm, polymerized LED light with intensity 600 mW /cm² for 20 seconds, plus with warmup use tool sterilizer dry for 10 minutes at a temperature of 110 0 C.

Materials used in the research This is :

1. Composite resin type *nanohybrid*, Z350 brand produced by 3M ESPE, *filler load* 78.2%
2. Composite resin type *hybrid*, brand P 60 3M ESPE production, *filler load* 61%



Figure 3.1 Materials research (A) Composite *nanohybrid* Z350 and (B) Composite *Hybrid* P60

Tools used includes :

1. Mold composite with the main material mold made from metal print composite cylinder with a diameter of 3 mm, height 6 mm

2. Ash 49, cement stopper, and *petri disk*
3. LED *light curing unit*, which is set to emit intensity 600 mW /cm² at activated. High intensity measured with tool gauge intensity.
4. Sterilizer dry
5. Machine tester strength Press (*LRX Plus Lloyd Instrument*)



(A)



(B)

Figure 3.2 Tools For make specimen, (A) cement stopper and Ash 49, (B) tool print composite



(A)



(B)

Figure 3.3 Tools For *curing* and *post curing* specimen, (A) Curing light, (B) sterilizer dry



Figure 3.4 Strength testing equipment Press (*LRX Plus Lloyd Instrument*)

Working procedure

In doing study created work procedures as following :

1. Make specimen. With tools made special, input layer by layer composite ($\pm 2\text{mm}$) to in mold Then pressed until solid and flat, exposed to light, until fulfil mold, at the stage end compression surface over the top cleaned, leveled using Ash 49. Polymerization composite from direction on with *LED curing light* for 20 seconds, for measure intensity light to remain 600 mW/cm^2 used tool gauge.
2. After hard, surface specimen ensured to be flat and smooth. Specimen consists of top 2 group, namely group A of types of composite resin *hybrid* and B type composite resin *nanohybrid* each 20 specimens. All specimen done *post curing* use tool sterilization dry for 10 minutes at a temperature of 110°C
3. Testing and calculation mark strength press. Specimen placed on *Universal Testing Machine* (LLYOD) test table below burden press until contact with sample, so that center burden machine is at in direction vertical from middle surface specimen. Activate test machine, give burden in a way continuous with speed of 1 mm/min , until formed cracks or fracture in the specimen.

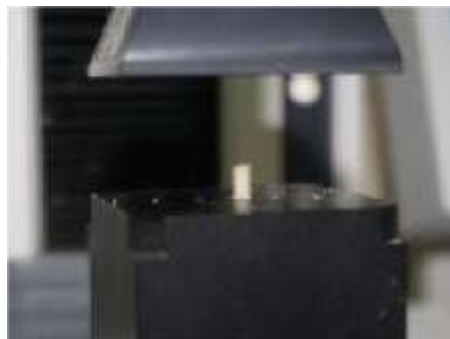


Figure 3.5 Placement specimen on the “ table ” tool measuring strength press

Research result

Testing strength press performed on 20 specimens composite *hybrid* and 20 specimens composite *nanohybrid*, which everything *post curing* warmup dry. Every specimen in accordance with his group, a strength test was carried out press use tool *Universal Testing Machine (LLYOD)* below burden continuous with speed 1 mm/ min and value obtained moment tool show *stress of break*, namely moment specimen cracks whose data in a way direct stored on the computer.

Furthermore all result data measurement tested in a way statistics. Measurement results strength press composite *hybrid* and composite *nanohybrids* all of which *post curing* with warmup dry can seen in Table 4.1.

Test Results Composite Compressive Strength *Hybrid* and Composite *Nanohybrid*

Specimen No.	Stress at Break (MPa)	
	Nanohybrid	Hybrid
1	302.73	178.35 97.19
2	140.92	176.68 17.55
3	121.6	157.68
4	170.33	239.98
5	110.63 245	178.16
6	275.36	276.45
7	196.69	245.97 69.69
8	144.29	191.25
9	157.04	162.66
10	257.85	157.94
11	100.96	195.95 125
12	233.48 100	178.67
13	176.06	203.29
14	312.06	23.44
15	251.48	117.8
16	147.71	139.67
17	213.8	
18		
19		
20		
Average	192.52	156.58

The table above show average strength results press For composite *nanohybrid* 192.52 Mpa and composite *hybrid* 156.58 Mpa. Figure 4.1 shows chart average strength ratio press composite *hybrid* and composite the whole *nanohybrid post curing* with warmup dry.

Amount measured specimens in a way both in the composite test group 19 *nanohybrids* specimen, because One specimen mark *stress of break* his No measurable.

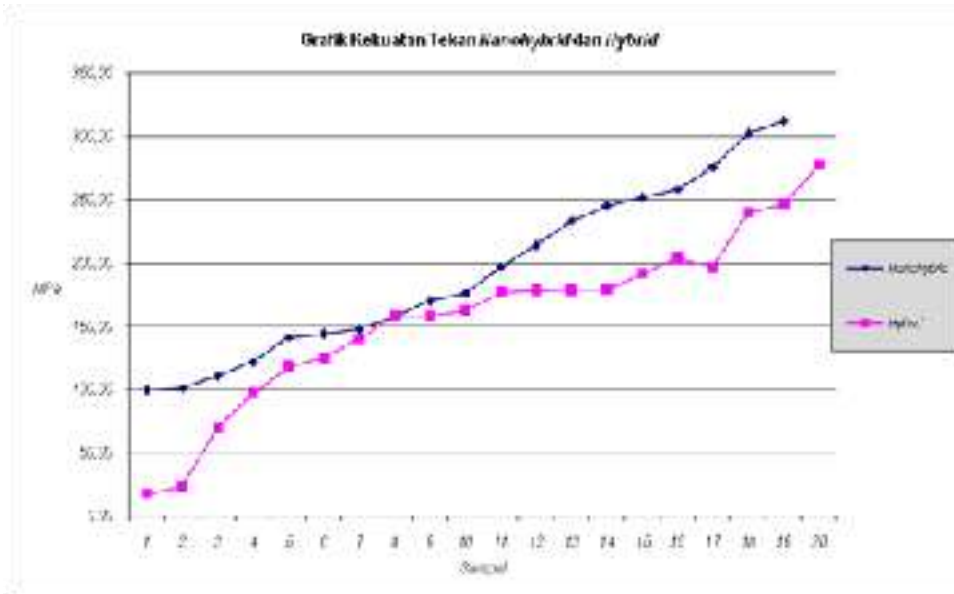


Figure 4.1 Research Results Graph

Analysis Statistics

The data in Table 4.1 are analyzed use *t test*. Test of equality of two power means press between composite *hybrid* and composite *nanohybrid* can seen in Table 4.2. which shows results *t* - test analysis testing strength press on two types different composites.

Table 4.2 Test Similarity of Two Averages

	Hybrid	Nanohybrid
mean	156.65	192.52
std. dev.	67,694	68,182
n	20	19
t	2.69	2.16

37	df
35,86829	difference (S. Break (Mpa) - S. Break (Mpa)) (Hybrid -nanohybrid)
4.614,71612	pooled variance
21,76271	standard error of difference
0.00000	hypothesized difference
1.65	t count
,0539	p-value (one-tailed)
,1078	p-value (two- tailed)

In Table 4.2 above, *t* count of 1.65 with *p-value* > 0.01. Meaning results testing No significant although average strength value press second type composite different. From the specimens tested For every type composite average strength obtained press composite *nanohybrid* 192.52 Mpa and average strength press composite *hybrid* 156.65 Mpa. Average strength is different between composite *nanohybrid* and composite *hybrid*, composite *nanohybrid* more big, but No can concluded that composite *nanohybrid* more Good compared

to composite *hybrid*. So the hypothesis states there is difference strength press to composite *hybrid* and *nanohybrid* are rejected.

Discussion

Research result show the presence of difference strength press between composite *nanohybrid* and composite *hybrid*, from analysis statistics show difference strength press between composite *nanohybrid* with composite *hybrid* No significant. Average strength press composite *nanohybrid* 192.52 Mpa and average strength press composite *hybrid* 156.65 Mpa, average strength of composite *nanohybrid* more big compared to composite *hybrid*. Amount *organic filler* composite *nanohybrid* against content overall reaching 78 wt % and composite *hybrid* only 61 wt %, the amount more *filler* Lots give impact to strength physical and mechanical properties of composites. 7

The results of the study tested strength press composite *hybrid* and *nanohybrid post curing* use *light box* shows results composite *hybrid* in a way significant more Good strength press it compared to *nanohybrid*. 29 These things related with many content *filler* in composite *nanohybrid* causes ray experience difficulty penetration that will inhibits the polymerization process, comparison important *filler* Because penetration ray to in composite more difficult If proportion higher *filler*. 30

Strength test press on research This use tool *Universal Testing Machine* (LLYOD) below burden continuous with speed 1 mm/min press until moment tool contact with specimen center burden machine is at in direction vertical from middle surface specimens that cause specimen cracked until broken, then can determined mark *stress at break* with unit Mpa who stating the limits of power press specimen.

Form specimen cylinder with size height twice the diameter is designed so that the distribution pressure on the surface composite more evenly distributed. 16 On study In this case, the specimen diameter is 3 mm so height made to 6 mm, based on ISO 9917, in testing strength press form specimen cylinder with dimensions comparison height and diameter 2:1. 31

Specimen to three group *nanohybrid Stress at break* – nya No measurable, because specimen No destroyed up to the specified limit, on the specimen third This obtained mark *Stress at Maximum load* is 707.72 Mpa. Observation show 3rd specimen in the group *nanohybrid* uneven surface so that distribution pressure No evenly. The compression process as well as manipulation specimen on the mold composite play a role important. Research This No repeated, and at the time calculation statistics, decided amount specimen group *nanohybrid* counted as many as 19 pieces.

Restoration composite indirect, *post curing* as polymerization addition done For increase degrees conversion, which then will increase properties mechanical restoration the composite. 8 Polymerization composite at temperature room always No perfect, ranging from 48-60%, monomers are not polymerized perfect, happened Because penetration rays that are not until with perfect to all over particle *filler* and composite resin matrix. 6,8,20 Warmup with temperature 110 o C for 10 minutes increase degrees conversion of the remaining monomers so that happen polymerization continued and will increase composite resin hardness.

Reich et.al, stated that composite *microhardness* No only depending on the increase *degree of polymerization*, but also depends amount *filler*, so that characteristic mechanical composite indirect influenced by distribution *filler*, type *filler*, shape, and silanization process to resin matrix. ³² This related with suspicion that contact surface high *filler* to resin matrix in composites *nano* will increase strength composite materials. ⁷ In composites *nanohybrid* size more *filler* small, so that the amount more Lots unit volume, with wide surface more big adhesion to more resin matrix wide.

Research result This No can show in a way significant difference between composite *nanohybrid* and composite *hybrid*, although thus on average composite *nanohybrid* more big strength press it. Technology *nano* with appearance good aesthetics when polished, it turns out produce strength good material anyway, so type composite *nanohybrid* can utilized For restoration anterior and posterior teeth.

CONCLUSION

Based on research and analysis statistics to results research, withdrawn conclusion No There is significant difference strength press between composite *nanohybrid* and composite *hybrid post curing* with warmup sterilizer dry. *Post curing* warmup dry use composite *nanohybrid* can become options on restoration posterior teeth technique indirect. Dentist must understand characteristic physique composite as well as its application in practice daily.

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