



# **Effect of Light Curing Distance of Different Bulkfill Composites on Top to Bottom Microhardness**

Thesis Submitted to the Faculty of Dentistry, Ain Shams University in  
Partial Fulfilment of the Requirements of Master Degree in  
Operative Dentistry

**By**

**Amr Mohamed Marzouk Nadeem**  
B.D.S - Future University in Egypt (2011)  
Teaching assistant - Future University

**Faculty of Dentistry  
Ain Shams University  
2018**



# **SUPERVISORS**

## **Dr. Mokhtar Nagy Ibrahim**

Professor of Operative Dentistry,  
Faculty of Dentistry, Ain Shams University

## **Dr. Hanan Abdel Aziz Niazi**

Professor of Operative Dentistry,  
Faculty of Dentistry, Ain Shams University

## **Dr. Mohammed Nasser Mohammed Anwar**

Lecturer of Operative Dentistry,  
Faculty of Dentistry, Ain Shams University

## **Dr. Rasha Hassan Afifi**

Lecturer of Operative Dentistry,  
Faculty of Dentistry, Future University in Egypt



# Acknowledgement

*First and foremost, thanks **God** for everything,*

*I would like to express all my heart full thanks and sincere gratitude to our mentor **Dr. Mokhtar Nagy Ibrahim**, Professor of Operative Dentistry, Faculty of Dentistry, Ain Shams University for his priceless and invaluable help, finally may his soul rest in peace.*

*I would like to express all my sincere gratitude and grateful appreciation to **Dr. Hanan Niazi**, Professor of Operative dentistry, Faculty of Dentistry, Ain Shams University for her continuous advice, supervision and valuable comments.*

*I would like to express my deep gratitude and thanks to **Dr. Mohammed Nasser**, lecturer of operative dentistry, Faculty of Dentistry, Ain Shams University for his continuous cooperation throughout this study.*

*I would like to express all my thanks and Concerns to **Dr. Rasha Hassan Afifi**, Lecturer of Operative dentistry, Faculty of Dentistry, Future University for her help and valuable comments.*

*I would like to express all my heart full thanks and sincere gratitude to my mentor **Dr. Essam Abdelhafez Naguib**, professor and head of Operative Dentistry department, Future University for his priceless, invaluable help, for his time and support.*

*Last but not least, my special thanks for all staff members of operative dentistry in Future University, for standing by my side all through the course of this study.*



# Dedication

*This thesis is dedicated to all those people whom I love  
and whose images I always carry in my heart.*

*From the depth of my heart I dedicate it to  
my loving parents, my wife, my little kids and my sister  
for their lifelong inspiration for me to be the best, for their endless  
love, support and countless sacrifices*





# **List of Contents**

<b>List of Tables .....</b>	<b>II</b>
<b>List of Figures .....</b>	<b>IV</b>
<b>List of abbreviations .....</b>	<b>VI</b>
<b>Introduction .....</b>	<b>1</b>
<b>Review of literature .....</b>	<b>3</b>
<b>Aim of the study .....</b>	<b>29</b>
<b>Materials and Methods .....</b>	<b>30</b>
<b>Results .....</b>	<b>41</b>
<b>Discussion .....</b>	<b>81</b>
<b>Summary and Conclusions .....</b>	<b>92</b>
<b>References .....</b>	<b>95</b>
<b>Arabic Summary .....</b>	<b>-</b>



# LIST OF TABLES

<b>Table no.</b>	<b>Title</b>	<b>Page no.</b>
<b>1</b>	Materials, brand name, composition, manufacturers and batch number .....	<b>31</b>
<b>2</b>	Variables of the study .....	<b>32</b>
<b>3</b>	Interaction of variables of the study .....	<b>33</b>
<b>4</b>	Multivariant ANOVA showing the effect of Curing time, distance and materials on mean microhardness .....	<b>42</b>
<b>5</b>	Mean and standard deviation (SD) for the effect of different materials on top and bottom microhardness.....	<b>43</b>
<b>6</b>	Mean and standard deviation (SD) of top and bottom microhardness for the tested materials with different curing times and curing distances .....	<b>47</b>
<b>7</b>	Mean and standard deviation (SD) for the effect of curing distance on top and bottom microhardness.....	<b>49</b>
<b>8</b>	Mean and standard deviation (SD) for the effect of Curing distance on top and bottom microhardness of the tested materials with different curing times.....	<b>53</b>
<b>9</b>	Mean and standard deviation (SD) for the effect of curing time on top and bottom microhardness .....	<b>55</b>
<b>10</b>	Mean and standard deviation (SD) for the effect of curing time on top and bottom microhardness with different curing distances .....	<b>59</b>
<b>11</b>	Mean and standard deviation (SD) for top microhardness mean values of all tested groups .....	<b>61</b>
<b>12</b>	Mean and standard deviation (SD) for bottom microhardness mean values of all tested groups .....	<b>63</b>
<b>13</b>	Three-way ANOVA showing the effect of Curing time, curing distance and materials on mean Top/Bottom ratio....	<b>66</b>
<b>14</b>	Mean and standard deviation (SD) for the effect of different materials on top to bottom microhardness .....	<b>67</b>

<b>Table no.</b>	<b>Title</b>	<b>Page no.</b>
<b>15</b>	Mean and standard deviation (SD) for Top/Bottom microhardness ratio for the tested materials with different curing times and curing distances .....	<b>69</b>
<b>16</b>	Mean and standard deviation (SD) for Top/Bottom ratio for for the effect of different Curing distances on top to bottom microhardness .....	<b>71</b>
<b>17</b>	Mean and standard deviation (SD) for Top/Bottom ratio for effect of different Curing distances on top to bottom microhardness ratio of the tested materials with different curing times.....	<b>73</b>
<b>18</b>	Mean and standard deviation (SD) for Top/Bottom microhardness ratio .....	<b>75</b>
<b>19</b>	Mean and standard deviation (SD) for the effect of different Curing time on top to bottom microhardness of the tested materials with different curing distances.....	<b>77</b>
<b>20</b>	Means and standard deviation (SD) for top to bottom microhardness ratio of all the tested groups .....	<b>79</b>

# LIST OF FIGURES

<b>Fig. no.</b>	<b>Title</b>	<b>Page no.</b>
<b>1</b>	Filtek bulkfill, Tetric Evoceram, Admira fusion xtra.....	<b>30</b>
<b>2</b>	Split Teflon mold.....	<b>34</b>
<b>3</b>	celluloid strip and microscopic slide placed below and above the mold.....	<b>34</b>
<b>4</b>	Light curing tip placed directly over the mold.....	<b>36</b>
<b>5</b>	A holder coupled to the light curing unit.....	<b>36</b>
<b>6</b>	Light curing distance controlled by a digital caliper .....	<b>37</b>
<b>7</b>	Electronic digital caliper.....	<b>37</b>
<b>8</b>	Elipar light curing unit.....	<b>38</b>
<b>9</b>	Demetron radiometer.....	<b>38</b>
<b>10</b>	speciemen marked with a permanent marker.....	<b>39</b>
<b>11</b>	Digital Vickers test .....	<b>40</b>
<b>12</b>	Mean microhardness for top and bottom surfaces of the different tested materials .....	<b>44</b>
<b>13</b>	Mean top and bottom microhardness for the tested materials with different curing times and curing distances .....	<b>48</b>
<b>14</b>	Mean microhardness for the top and bottom surfaces with different Curing Distance .....	<b>50</b>
<b>15</b>	Mean microhardness values for top and bottom surfaces of different tested materials with different curing times .....	<b>54</b>
<b>16</b>	Mean microhardness for the top and bottom surfaces with different curing time.....	<b>56</b>
<b>17</b>	Mean top and bottom microhardness values for the effect of curing time on different tested materials with	<b>60</b>

<b>Fig. no.</b>	<b>Title</b>	<b>Page no.</b>
	different curing distances .....	
<b>18</b>	The top surface microhardness mean values of all the tested groups.....	<b>62</b>
<b>19</b>	The bottom microhardness mean values of all the tested groups.....	<b>64</b>
<b>20</b>	Mean Top/Bottom ratio of different tested materials.....	<b>68</b>
<b>21</b>	Mean Top/Bottom ratio for the tested materials with different curing times and curing distances.....	<b>70</b>
<b>22</b>	Mean Top/Bottom microhardness ratio with different curing distances .....	<b>71</b>
<b>23</b>	Mean top/bottom microhardness ratio of different tested materials with different curing times .....	<b>74</b>
<b>24</b>	Mean Top/Bottom microhardness ratio of the tested materials with different curing times .....	<b>75</b>
<b>25</b>	Mean Top/Bottom microhardness ratio of different tested materials with different curing distances .....	<b>78</b>
<b>26</b>	Mean microhardness top to bottom ratio for of all the tested groups.....	<b>80</b>

## LIST OF ABBREVIATIONS

<b>BFMS</b>	Bulkfill Materials
<b>BIS-GMA</b>	Bisphenol A glycerolate dimethacrylate
<b>c-c</b>	Carbon double bond
<b>CIE</b>	Commission Internationale d'Eclairage
<b>CQ</b>	Camphorquinone
<b>DC</b>	Degree of cure
<b>FTIR</b>	Fourier Transform Infrared Spectroscopy
<b>HEMA</b>	Hydroxy ethyl methacrylate
<b>LCU</b>	Light curing unit
<b>LED</b>	Ligh emitting diode
<b>mm</b>	Millimetre
<b>nm</b>	Nano meter
<b>ORMOCERS</b>	Organically modified ceramics
<b>RBCS</b>	Resin based composites
<b>S</b>	Seconds
<b>TEGDMA</b>	Triethylene Glycol Dimethacrylate
<b>TLE</b>	Total light energy
<b>T-S distance</b>	Distance between the tip of the light curing unit and the surface of restoration
<b>VHN</b>	Vickers hardness number
<b>VHR</b>	Vickers hardness ratio (VHR).
<b>DOC</b>	Depth of cure
<b>KHN</b>	Knoop hardness number
<b>QTH</b>	quartz tungsten halogen