

TOTALFILL®



SCIENTIFIC OVERVIEW
10/2021



TotalFill® BC Sealer™

Bioceramic sealers are indicated for the following uses:

- Permanent obturation of the root canal following vital pulp-extirpation.
- Permanent obturation of the root canal following removal of infected or necrotic pulp and placement of intracanal dressings.

TotalFill® BC Sealer™ for cold obturation or TotalFill® BC Sealer™ HiFlow for warm obturation.

TotalFill® BC RRM™

Bioceramic repair materials are indicated for the following uses:

- Repair of Root Perforation
- Repair of Root Resorption
- Root End Filling
- Apexification
- Pulp Capping

The current literature overview aims to identify all articles published on the TotalFill range of products. To do so, the pubmed (*National Center for Biotechnology Information (NCBI). Bethesda (MD), USA, 2021. Available from: <https://www.ncbi.nlm.nih.gov/>*) database was searched using the keyword "Totalfill". All articles published until October 1st, 2021 were selected. No other restriction was applied to the search.

All articles retrieved during the search were regrouped in 6 different categories:

In vivo - highlights the articles that report studies performed on living subjects (human and animal).

Biocompatibility & Bioactivity – (Biocomp) articles that focus on body response (e.g. cytotoxicity, inflammatory reaction, mineralization, calcium release, ...) induced by the material.

Antibacterial Effect – articles that investigate the effect of the material on bacteria (e.g. inhibition, bactericide, ...).

Retreatability – articles that investigate retreatability of the material.

Pulp Capping – articles reporting on vital pulp therapies (e.g. pulp capping and pulpectomy).

Properties of the Material – articles assessing the chemical and/or the physical properties of the material.

| | | | | | | x Topic investigated into the article |
|------------------------------------|--------------------------------|----------------------|----------------|--------------|----------------------------|--|
| IN VIVO | BIOCOMPATIBILITY & BIOACTIVITY | ANTIBACTERIAL EFFECT | RETREATABILITY | PULP CAPPING | PROPERTIES OF THE MATERIAL | |
| 2021 – TotalFill® BC Sealer | | | | | | |
| | x | | | | | <p style="text-align: center;">(1) M. A. Elsayed et al. <i>Eur. Endod J.</i> 2021</p> <p>Compared with: MTA Fillapex Comments: TotalFill exhibits high apatite formation, high Ca²⁺ ion release, and high Ca/P ratio. This is linked to better biological sealing ability and stimulation of new bone deposition. In comparison, MTA Fillapex showed lower and delayed bioactivity.</p> |
| | | x | | | | <p style="text-align: center;">(2) R. F. Zancan et al. <i>Int. Endod. J.</i> 2021</p> <p>Compared with: AH+, BioRoot RCS, MTA Fillapex Comments: Removal of smear layer was correlated with improved bacterial reduction in the dentinal tubules. The irrigation protocol (2% NaOCl vs. 2% NaOCl + 17% EDTA) did not influence the antibacterial effect of TotalFill. BioRoot RCS exhibited the highest antibacterial effect and dentinal tubule penetration.</p> |
| x | x | | | | | <p style="text-align: center;">(3) J. M. Santos et al. <i>Biomedicines.</i> 2021</p> <p>Compared with: TotalFill Hiflow, AH+ Comments: On a rat model, inflammatory reaction, macrophage infiltrate, and mineralization were observed after 8- and 30-days implantation. AH+ presented a higher inflammatory score at both days when compared to TotalFill BC Sealer and Hiflow. Hiflow showed a higher mineralization potential and macrophage infiltrate than AH+. Biocompatibility and bioactivity potential was demonstrated for TotalFill BC Sealer and TotalFill Hiflow. AH+ did not induce bioactivity.</p> |

| | IN VIVO | BIOCOMP | ANTIBACTERIAL | RETREATABILITY | PULP CAPPING | PROPERTIES |
|---|---------|---------|---------------|----------------|--------------|--|
| x | | | | | | <p>(4) H. S. G. Tan et al. <i>J. Endod.</i> 2021</p> <p>Compared with: AH+</p> <p>Comments: 163 patients were recruited for a study aiming at comparing postoperative pain. No difference between TotalFill and AH+ was observed. The postoperative pain level is related to the preoperative pain level rather than the obturation material</p> |
| | | | | | x | <p>(5) P. J. Palma et al. <i>Clin. Oral Investig.</i> 2021</p> <p>Compared with: Biodentine, Pulp capping material (Coltene)</p> <p>Comments: Bond strength. No statistical difference was observed between the tested materials at day 0. TotalFill and Biodentine showed a superior shear bond strength than PCM at day 7.</p> |
| x | x | | | | | <p>(6) E. C. A. Silva et al. <i>Int. Endod. J.</i> 2021</p> <p>Compared with: Experimental sealer based on tricalcium silicate, AH+</p> <p>Comments: TotalFill showed the highest bioactivity and biocompatibility among the commercial sealers on a rat model. The inflammation due to the treatment gradually reduced over time. The slowest recovery was observed for AH+.</p> |
| x | | | | | x | <p>(7) E. J. N. L. Silva et al. <i>Clin. Oral Investig.</i> 2021</p> <p>Compared with: BioC Sealer, AH+, Sealapex</p> <p>Comments: Compare in vitro vs. in vivo methods to test the setting time of different sealers. Setting times were different in-vitro and in vivo. AH Plus, BioC sealer and TotalFill BC sealer had set at 7 days in vivo. Sealapex did not set in vivo.</p> |

| 2020 - TotalFill® BC Sealer | | | | | |
|-----------------------------|---------|---------------|----------------|--------------|---|
| IN VIVO | BIOCOMP | ANTIBACTERIAL | RETREATABILITY | PULP CAPPING | PROPERTIES |
| | X | | | | <p>(8) M.-M. Almeida et al. <i>J. Clin. Exp. Dent.</i> 2020</p> <p>Compared with: AH +, MTA Fillapex Comments: TotalFill showed the longest setting time (initial and final), lower radiopacity than AH+ but similar to MTA Filapex, and lower flowability than AH+ but higher than MTA Filapex. AH+ and TotalFill were associated with lower volumetric changes than MTA Fillapex. TotalFill also exhibits the highest pH (7.07-8.6) and calcium release over time. Regarding biocompatibility, TotalFill showed the best results (lowest cytotoxicity) of all tested sealers.</p> |
| | | X | | | <p>(9) R. Bose et al. <i>J. Clin. Med.</i> 2020</p> <p>Compared with: BioRoots RCS, AH +, Tubli-seal Comments: Significant difference of reduction in viable counts was observed between BioRoot RCS and AH+. The highest biofilm inhibition was demonstrated for TotalFill and BioRoot RCS. BioRoot RCS presented with the highest microbial killing, followed by TotalFill BC and Tubli-seal. Alkalizing activity was seen from the onset by BioRoot RCS, TotalFill BC and AH Plus. Effective microbial properties were superior for TotalFill and BioRoot RCS when compared to epoxy-based and zinc oxide-eugenol-based sealers.</p> |
| | | X | | | <p>(10) A. Katakidis et al. <i>Restor. Dent. Endod.</i> 2020</p> <p>Compared with: BioRoots RCS, Sealapex Comments: TotalFill BC Sealer demonstrated the highest flow. The bioceramic sealers initially presented higher alkaline activity than the polymeric calcium hydroxide sealer. However, at 3 and 4 weeks post-immersion (i.e. when the sealers had fully set), all sealers had similar pH values.</p> |

| IN VIVO | BIOCOMP | ANTIBACTERIAL | RETREATABILITY | PULP CAPPING | PROPERTIES | |
|---------|---------|---------------|----------------|--------------|------------|---|
| | | | | | X | <p>(11) M. Hadis and J. Camilleri. <i>Dent. Mater. Off. Publ. Acad. Dent. Mater.</i> 2020</p> <p>Compared with: TotalFill BC Sealer Hiflow Comments: None of the sealers are irreversibly affected by the heat generated during warm vertical obturation. After cooling down, the chemical compositions returned to initial status.</p> |
| | | | | | X | <p>(12) A. Almohaimede et al. <i>Eur. Endod. J.</i> 2020</p> <p>Compared with: AH+ Comments: No significant difference was observed between TotalFill and AH+ in terms of resistance to fracture.</p> |
| | | X | | | | <p>(13) M. Garrib and J. Camilleri. <i>J. Dent.</i> 2020</p> <p>Compared with: None Comments: 17% EDTA and 10% formic acid applied for 5 minutes used in conjunction with mechanical instrumentation achieved over 95% removal of GP and sealer. This protocol also achieved patency and reestablishment of the working length while not damaging the dentin.</p> |
| | | | | | X | <p>(14) Y. T. Mohammed and I. M. Al-Zaka. <i>J. Contemp. Dent. Pract.</i> 2020</p> <p>Compared with: AH+, GuttaFlow 2, MTA-Fillapex Comments: TotalFill BC sealer with BC cones enhanced the in-vitro fracture resistance of endodontically treated teeth compared to the other sealers tested.</p> |
| | | X | | | | <p>(15) M. Šimundić Munitić et al. <i>Acta Stomatol. Croat.</i> 2020</p> <p>Compared with: BioRoots RCS, MTA Fillapex, AH+ Comments: TotalFill and AH+ presented a significant superior antibacterial (<i>E. faecalis</i>) effect when compared to BioRoot RCS and MTA Fillapex</p> |

| IN VIVO | BIOCOMP | ANTIBACTERIAL | RETREATABILITY | PULP CAPPING | PROPERTIES |
|------------------------------------|---------|---------------|----------------|--------------|---|
| | | | | | <p>(16) A. R. Atmeh et al. <i>Int. Endod. J.</i> 2020</p> <p>Compared with: AH+, Pulp Canal Sealer, BioRoot RCS</p> <p>Comments: It is not recommended to heat zinc oxide-based sealers. Epoxy resin and calcium silicate-based sealers shall be heated above 100°C. However, TotalFill recovered its initial composition after cooling down.</p> |
| | | | | | <p>(17) F. F. E. Torres et al. <i>Int. Endod. J.</i> 2020</p> <p>Compared with: Sealer Plus BC, Bio-C Sealer, AH+</p> <p>Comments: The epoxy resin showed the least changes after immersion in PBS and distilled water. No difference between TotalFill and Sealer Plus BC was observed in terms of mass loss and volumetric change. Both sealers exhibited less mass and volume loss than Bio-C Sealer. The presence of voids was similar for all tested sealers.</p> |
| 2019 - TotalFill® BC Sealer | | | | | |
| | x | x | | | <p>(18) A. Koutroulis et al. <i>Sci. Rep.</i> 2019</p> <p>Compared with: TotalFill RRM, Bio-C Pulpo, Biodentine, Theracal, ACTIVA BioACTIVE Base/Liner, TCS replaced with 30% ZO radiopacifier (TCS/ZO), TCS/ZO with 15% CP replacement in the cementitious phase (TCS-CP/ZO), TCS/ZO with 10 or 20% micro-silica replacement of the cement (TCS-mS10/ZO, TCS-mS20/ZO respectively).</p> <p>Comments: Increased calcium release (bioactivity), antibacterial activity, and effect in cell metabolic activity were highlighted for TotalFill RRM, Bio-C Pulpo, and Biodentine. High cell viability (>70%, biocompatibility) and effective antibacterial effect for all tested strains was reported for TotalFill RRM</p> |
| | x | | | | <p>(19) S. López-García et al. <i>Materials.</i> 2019</p> <p>Compared with: Bio-C, AH+</p> <p>Comments: Bioceramic sealers demonstrated better cytocompatibility in terms of cell viability, migration, cell morphology, cell attachment and mineralization capacity than AH Plus.</p> |

| | IN VIVO | BIOCOMP | ANTIBACTERIAL | RETREATABILITY | PULP CAPPING | PROPERTIES |
|--|---------|---------|---------------|----------------|--------------|--|
| | | | | | | <p>(20) C. L. Zordan-Bronzel et al. <i>J. Endod.</i> 2019 Compared with: Bio-C, AH+ Comments: No difference regarding radiopacity, volumetric change, and pH was observed between TotalFill and Bio-C Sealer. AH+ had the highest radiopacity and the lowest flowability, pH, solubility, and volumetric change</p> |
| | | | | | | <p>(21) A. S. Al-Hiyasat and S. A. Alfirjani. <i>J. Dent.</i> 2019 Compared with: AH+ Comments: Bond strength. TotalFill has a higher bond strength than AH+. The obturation technique (cold lateral compaction, single cone, and warm vertical compaction) did not influence the bond strength of TotalFill.</p> |
| | | | | | | <p>(22) P. Reszka et al. <i>Dent. Med. Probl.</i> 2019 Compared with: GuttaFlow Bioseal Comments: The authors claim that TotalFill showed a higher degree of purity compared to GuttaFlow.</p> |
| | | | x | | | <p>(23) S. Alsubait et al. <i>Odontology.</i> 2019 Compared with: BioRoots RCS, AH+ Comments: This study showed that calcium silicate sealer have a higher antibacterial activity than epoxy resin based sealer. On day 7, TotalFill showed the highest amount of dead bacteria. BioRoot reduced the bacterial load by 61.75% at day 30.</p> |
| | x | | | | | <p>(24) C. L. Zordan-Bronzel et al. <i>Int. Endod. J.</i> 2019 Compared with: Experimental calcium silicate-based sealer, AH+ Comments: All sealers were rated as non-cytotoxic. In addition, TotalFill and the experimental sealer were significantly more effective in terms of antibacterial and antibiofilm effect</p> |

| | | | | | | IN VIVO | BIOCOMP | ANTIBACTERIAL | RETREATABILITY | PULP CAPPING | PROPERTIES | |
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| | | | | | | | x | | | | x | (25) F. Zamparini et al. <i>Clin. Oral Investig.</i> 2019 Compared with: TotalFill RRM Putty, TotalFill RRM paste Comments: These materials exhibit excellent physicochemical properties and bioactive properties. Their marked ability to nucleate B-type carbonate apatite, offer many biological advantages over materials used for similar indications. |
| | | | | | | | | | | | x | (26) Z. U. Aydın et al. <i>Odontology.</i> 2019 Compared with: None Comments: Sealer penetration in tubules. Deeper sealer penetration in tubules was observed in teeth treated with EDTA and QMix when compared to chitosan nanoparticles. |
| 2018 - TotalFill® BC Sealer | | | | | | | | | | | | |
| | | | | | | | | | | | | (27) F. Kakoura and O. Pantelidou. <i>J. Conserv. Dent. JCD.</i> 2018 Compared with: AH26, BioRoot RCS Comments: To evaluate residual filling material and re-establishment of working length and apical patency after retreatment of BioRoot RCS, versus TotalFill BC Sealer and AH26 used in single cone obturation. All the sealers were removed to a similar extent. The working length and patency were reestablished sufficiently in all groups. |
| | | | | | | | | | | | x | (28) S. Osiri et al. <i>J. Endod.</i> 2018 Compared with: AH+ Comments: Fracture resistance. No difference between the sealers was observed. They exhibited the same resistance than intact roots. |
| | | | | | | | | | | | x | (29) S. Germain et al. <i>J. Contemp. Dent. Pract.</i> 2018 Compared with: Experimental BC sealer, AH+ Comments: Sealing ability. No difference in terms of voids was observed between the tested sealers and conditions. |

| IN VIVO | BIOCOMP | ANTIBACTERIAL | RETREATABILITY | PULP CAPPING | PROPERTIES |
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| | | | | x | <p>(30) E. M. Kamal et al. <i>Dent. Med. Probl.</i> 2018</p> <p>Compared with: Biodentine, TheraCal LC</p> <p>Comments: Similar results were obtained for the 3 direct pulp capping materials in terms of dentin bridge thickness.</p> |
| | x | | | | <p>(31) V. Taraslia et al. <i>Eur. J. Dent.</i> 2018</p> <p>Compared with: MTA Fillapex, GuttaFlow 2, BioRoot RCS, Roth's 801, AH+</p> <p>Comments: TotalFill and BioRoot RCS showed no or mild cytotoxic effect whereas all other sealers were moderately to severely cytotoxic. The bioceramic sealers were too soluble in regards of the ISO 6876. TotalFill and EasySeal killed all bacteria independently of the time point tested in the direct contact test.</p> |
| | x | | | x | <p>(32) M. Colombo et al. <i>J. Clin. Exp. Dent.</i> 2018</p> <p>Compared with: MTA Fillapex, BioRoot RCS, Sealapex, EasySeal, AH+</p> <p>Comments: TotalFill and BioRoot RCS showed no or mild cytotoxic effect whereas all other sealers were moderately to severely cytotoxic. The bioceramic sealers were too soluble in regards of the ISO 6876. TotalFill and EasySeal killed all bacteria independently of the time point tested in the direct contact test.</p> |
| | | x | | | <p>(33) V. Kapralos et al. <i>J. Endod.</i> 2018</p> <p>Compared with: RoekoSeal, GuttaFlow 2, AH+</p> <p>Comments: TotalFill was the only efficient sealer against planktonic bacteria (<i>E. faecalis</i>, <i>S. mutans</i>, <i>S. epidermis</i>, and <i>S. aureus</i>). On biofilms AH+ was the most effective followed by TotalFill. RoekoSeal and GuttaFlow 2 showed no antibacterial effect</p> |
| | | | | x | <p>(34) S. Kadić et al. <i>Clin. Oral Investig.</i> 2018</p> <p>Compared with: MM-MTA, Biodentine, TotalFill BC RRM</p> <p>Comments: Bond strength. TotalFill RRM showed a significant higher bond strength when compared to the other materials. Similar fracture modes were observed for the 3 root-end filling material.</p> |

IN VIVO

BIOCOMP

ANTIBACTERIAL

RETREATABILITY

PULP CAPPING

PROPERTIES

2017 – TotalFill® BC Sealer

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| | | | | | | <p>(35) M. Tanomaru-Filho et al. <i>J. Endod.</i> 2017</p> <p>Compared with: GuttaFlow Bioseal, AH+</p> <p>Comments: TotalFill showed the highest values in terms of setting time, pH, solubility, and flow. High pH and calcium release are considered as the mechanisms for mineralized tissue repair.</p> |
| | | | | | | <p>(36) C. Poggio et al. <i>J. Clin. Exp. Dent.</i> 2017</p> <p>Compared with: BioRoot RCS, MTA Fillapex, Sealapex, EasySeal, Pulp Canal Sealer, N2, AH+</p> <p>Comments: TotalFill and BioRoot RCS showed the highest solubility and pH.</p> |
| | | | | | | <p>(37) C. Poggio et al. <i>J. Clin. Exp. Dent.</i> 2017</p> <p>Compared with: BioRoot RCS, MTA Fillapex, Sealapex, EasySeal, Pulp Canal Sealer, N2, AH+</p> <p>Comments: The highest bactericidal effect was observed for TotalFill and EasySeal. N2 showed the highest antibacterial activity.</p> |
| | | | | | | <p>(38) C. Poggio et al. <i>J. Clin. Exp. Dent.</i> 2017</p> <p>Compared with: BioRoot RCS, MTA Fillapex, Sealapex, EasySeal, Pulp Canal Sealer, N2, AH+</p> <p>Comments: TotalFill and BioRoot RCS showed no or mild cytotoxic effect whereas all other sealers were moderately to severely cytotoxic. AH+ was non-cytotoxic at 24h but ended as severely cytotoxic at 72h. Moderate and severe cytotoxicity induced cell death (apoptosis).</p> |
| | | | | | | <p>(39) E. Turkel et al. <i>Photomed. Laser Surg.</i> 2017</p> <p>Compared with: AH+</p> <p>Comments: Sealer penetration in tubules. The activation method did not influence the penetration depth of TotalFill into tubules. Superior tubular penetration was observed for TotalFill when compared to AH+.</p> |

| IN VIVO | BIOCOMP | ANTIBACTERIAL | RETREATABILITY | PULP CAPPING | PROPERTIES | |
|---------|---------|---------------|----------------|--------------|------------|--|
| | | | | | | <p>(40) W. Y. Yap et al. Med. Princ. Pract. Int. J. Kuwait Univ. Health Sci. Cent. 2017</p> <p>Compared with: EndoREZ, AH+</p> <p>Comments: Bond strength. TotalFill and AH+ showed the highest bond strength independently of the obturation system. Their bond strength increased with time. EndoRez has a significant lower bond strength and it decreases with time.</p> |
| | | | | | | <p>(41) D. Hrab et al. Clujul Med. 2017</p> <p>Compared with: Experimental material based on hydroxyapatite with silver and zinc</p> <p>Comments: TotalFill showed a radiopacity of 4±0.15 mmAl, which is higher than the minimal requirement of 3 mmAl set into the ISO standard 6876. The experimental sealer presented similar results than TotalFill.</p> |
| | | | | | | <p>(42) F. J. Rodríguez-Lozano et al. Int. Endod. J. 2017</p> <p>Compared with: MTA Fillapex, AH+</p> <p>Comments: TotalFill showed significantly higher bioactivity (cell proliferation and cell adhesion) and lower cytotoxicity than MTA Fillapex and AH+.</p> |
| | | | | | | 2015 – TotalFill® BC Sealer |
| | | | | | | <p>(43) A. Agrafioti et al. Eur. J. Dent. 2015</p> <p>Compared with: MTA Fillapex, AH+</p> <p>Comments: TotalFill allowed retreatment (working length and patency reestablished) in 100% of the cases. Similar results were obtained for the 2 other sealers. Time required for retreatment was longer for the TotalFill group.</p> |

| 2021 – TotalFill® BC RRM | | | | | |
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| x | | | | x | <p style="text-align: center;">(44) J. M. Santos et al. <i>J. Endod.</i> 2021</p> <p>Compared with: ProRoot MTA, BioDentine, Experimental material</p> <p>Comments: TotalFill BC RRM Putty, ProRoot MTA, and BioDentine are considered as suitable for pulp capping procedures. Preoperative inflammation did not influence the outcomes of full pulpectomy.</p> |
| | | | | x | <p style="text-align: center;">(45) A. S. Al-Hiyasat et al. <i>BMC Oral Health.</i> 2021</p> <p>Compared with: MTA Angelus Gray, ProRoot White MTA, Biodentine, TheraCal LC</p> <p>Comments: Tooth discoloration. By the presence of blood, TotalFill and Biodentine showed the least tooth discoloration. In saline solution, Biodentine causes less discoloration than all other materials. ProRoot White MTA and MTA Angelus Gray showed the most tooth discoloration.</p> |
| | | | | x | <p style="text-align: center;">(46) R. Krug et al. <i>Clin. Oral Investig.</i> 2021</p> <p>Compared with: ProRoot MTA, Medcem MTA, Medcem Medical Portland Cement</p> <p>Comments: Tooth discoloration. No significant difference in tooth discoloration was observed between the tested sealers.</p> |
| 2020 – TotalFill® BC RRM | | | | | |
| | | | | x | <p style="text-align: center;">(47) S. Alsubait et al. <i>BMC Oral Health.</i> 2020</p> <p>Compared with: ProRoot MTA</p> <p>Comments: Bond strength. To compare the influence of intracanal medicaments (Ca(OH)₂ and mTAP) on the dislocation resistance of sealers. AH+ lose bond strength when combined with intracanal medication. However, the bond of TotalFill BC root repair material fast set putty remains stable.</p> |

| 2019 - TotalFill® BC RRM | | | | | |
|--------------------------|---------|---------------|----------------|--------------|--|
| IN VIVO | BIOCOMP | ANTIBACTERIAL | RETREATABILITY | PULP CAPPING | PROPERTIES |
| | | | | | <p>(48) S. Kadić et al. <i>Lasers Med. Sci.</i> 2019</p> <p>Compared with: None Comments: The highest dentin/RRM bond strength was achieved for cavities prepared with Er:YAG.</p> |
| | | | | | <p>(49) K. W. Al-Saudi et al. <i>Saudi Dent. J.</i> 2019</p> <p>Compared with: Neo MTA Plus Comments: TotalFill showed superior dentin bridge thickness at 3 months post-treatment. These more favorable conditions for pulp repair are probably due to high calcium release. Complete dentin bridge formation and an absence of inflammatory pulp response were observed for both materials at 3 weeks and 3 months post-treatment.</p> |
| | | | | | <p>(50) J. H. R. Chu et al. <i>Aust. Endod. J. J. Aust. Soc. Endodontology Inc.</i> 2019</p> <p>Compared with: MTA Angelus White Comments: Evaluate the effect of 5% NaOCl and 17% EDTA on the microhardness of MTA Angelus and TotalFill RRM Putty after 24hrs and 8 days. Allowing the materials to set for a week before exposing them to the irrigants improves their microhardness. Significant for perforation repair.</p> |
| | | | | | <p>(51) M. Juez et al. <i>J. Conserv. Dent. JCD.</i> 2019</p> <p>Compared with: ProRoot White MTA, BioDentine Comments: To compare the sealing ability of White MTA, BioDentine and TotalFill Root Repair Materials with a glucose leakage model after orthograde obturation using an open apex model. There was no statistical difference in leakage between the groups. Note: Different methods of placement of the materials add variables to the study.</p> |

| | IN VIVO | BIOCOMP | ANTIBACTERIAL | RETREATABILITY | PULP CAPPING | PROPERTIES |
|--|---------|---------|---------------|----------------|--------------|---|
| | X | | | | | <p>(52) M. R. W. Ali et al. <i>Eur. J. Oral Sci.</i> 2019</p> <p>Compared with: White MTA Angelus, Biodentine Comments: The duration and the concentration of the materials had an influence on the cell inhibition(human bone marrow mesenchymal stem cells). The differences observed were inconclusive in order to determine a material that would be superior to the others.</p> |
| | | | | | X | <p>(53) M. R. W. Ali et al. <i>Acta Biomater. Odontol.</i> 2019</p> <p>Compared with: White MTA ANGELUS, Biodentine, Gutta percha and AH+ Comments: No statistical difference between the cements was observed in terms of resistance to fracture.</p> |
| | X | | | | X | <p>(54) P. Lertmalapong et al. <i>J. Investig. Clin. Dent.</i> 2019</p> <p>Compared with: ProRootMTA, Biodentine, RetroMTA Comments: Leakage. To investigate bacterial leakage and marginal adaptation of bioceramic apical plugs.TotalFill BC RRM putty (3 and 4mm), Biodentine (3 and 4mm), ProRoot MTA (4mm) groups showed the best sealing ability and marginal adaptation of apical plugs.</p> |
| | X | | | | X | <p>(25) F. Zamparini et al. <i>Clin. Oral Investig.</i> 2019</p> <p>Compared with: TotalFill BC Sealer, TotalFill RRM Putty, TotalFill RRM paste Comments: These materials exhibit excellent physicochemical properties and bioactive properties. Their marked ability to nucleate B-type carbonate apatite, offer many biological advantages over materials used for similar indications.</p> |

References

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