Supplementary material

Supplementary Table 1. Excluded Studies Table.

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| Exclusion reason (total)  (For studies with more than 1 reason, only 1 reason will be given) | Excluded study |
| Animal study or *in vitro* study (19) | Biological parameters, discolouration and radiopacity of calcium silicate-based materials in a simulated model of partial pulpotomy |
| The Combined Effects of Hydraulic Calcium Silicate Cement and Enamel Matrix Derivative Regarding Osteogenic and Dentinogenic Differentiation on Human Dental Pulp Stem Cells |
| The Combined Effects on Human Dental Pulp Stem Cells of Fast-Set or Premixed Hydraulic Calcium Silicate Cements and Secretome Regarding Biocompatibility and Osteogenic Differentiation |
| Comparison of Dycal and formocresol pulpotomies in young permanent teeth in monkeys |
| Cytotoxicity and osteogenic potential of silicate calcium cements as potential protective materials for pulpal revascularization |
| Effect of Bioceramic Materials on Proliferation and Odontoblast Differentiation of Human Stem Cells from the Apical Papilla |
| Effect of Different Treatment Options on Biomechanics of Immature Teeth: A Finite Element Stress Analysis Study |
| The effects of hydroxyapatite and platelet rich plasma on apexogenesis in monkeys |
| Enhanced healing of tooth-pulp wounds in the dog by enriched collagen solution as a capping agent |
| Healing Capacity of Autologous Bone Marrow-derived Mesenchymal Stem Cells on Partially Pulpotomized Dogs’ Teeth |
| Histological evaluation of platelet rich plasma and hydroxiapatite in apexogenesis: study on experimental animals |
| Histopathological and immunohistochemical profiles of pulp tissues in immature dogs’ teeth to two recently introduced pulpotomy materials |
| Material Pulp Cells and Tissue Interactions |
| Response of human dental pulp capped with biodentine and mineral trioxide aggregate |
| Staining Potential of Neo MTA Plus, MTA Plus, and Biodentine Used for Pulpotomy Procedures |
| Tooth Discoloration Induced by Different Calcium Silicate-Based Cements: A Two-Year Spectrophotometric and Photographic Evaluation *in Vitro* |
| Vital pulp therapy in dogs: 190 cases (2001–2011) |
| Staining Potential of Neo MTA Plus, MTA Plus, and Biodentine Used for Pulpotomy Procedures |
| Impact of different disinfection protocols on the bond strength of NeoMTA 2 bioceramic sealer used as a root canal apical plug (*in vitro* study) |
| Case report (45) | Management of an Immature Necrotic Permanent Molar with Apical Periodontitis Treated by Regenerative Endodontic Protocol Using Calcium Hydroxide and MM-MTA: A Case Report with Two Years Follow Up |
| Fragment reattachment associated with pulpotomy in a posterior tooth with incomplete root formation |
| Regenerative endodontics procedure of an immature permanent mandibular molar with a necrotic pulp using biodentine: a 16 months radiographic follow-up |
| Apexogenesis of an immature permanent molar with irreversible pulpitis using mineral trioxide aggregate pulpotomy: A case report |
| Vital Pulp Therapy with Calcium-Silicate Cements: Report of Two Cases |
| Second-generation Platelet Concentrate (Platelet-rich Fibrin) as a Scaffold in Regenerative Endodontics: A Case Series |
| Treatment of Tooth Discoloration after the Use of White Mineral Trioxide Aggregate |
| Treatment of an immature complicated crown fracture: a case report |
| Biocompatibility and Antibiofilm Properties of Calcium Silicate-Based Cements: An *In Vitro* Evaluation and Report of Two Clinical Cases |
| Allogeneic Cellular Therapy in a Mature Tooth with Apical Periodontitis and Accidental Root Perforation: A Case Report |
| Treatment Options for Failing Regenerative Endodontic Procedures: Report of 3 Cases |
| Orthodontic Movement after Regenerative Endodontic Procedure: Case Report and Long-term Observations |
| Biodentine™ Partial Pulpotomy of a Young Permanent Molar with Signs and Symptoms Indicative of Irreversible Pulpitis and Periapical Lesion: A Case Report of a Five-Year Follow-Up |
| Apexification Associated With Coronal-Radicular Restoration in Permanent Anterior Teeth: Case Series |
| A New Calcium-silicate Cement in the Endodontic Treatment of Immature Permanent Teeth: A Report of Two Cases |
| Management of Dens Invaginatus Type II Associated with Immature Apex and Large Periradicular Lesion Using Platelet-rich Fibrin and Biodentine |
| Vital pulp therapy with three different pulpotomy agents in immature molars: a case report |
| Multidisciplinary Management of a Double Immature Permanent Tooth: A Case Report |
| Human amniotic membrane as therapeutic agent in pulpotomy of permanent molars |
| Management of bilateral invasive cervical resorption lesions in maxillary incisors using a novel calcium silicate-based cement: A case report |
| Regenerative Endodontic Treatment: Report of Two Cases with Different Clinical Management and Outcomes |
| Discrete pulp canal calcification in a case of full pulpotomy: A 2-year follow-up case report |
| Pulp management after traumatic injuries with a tricalcium silicate-based cement (Biodentine): a report of two cases, up to 48 months follow-up |
| Endodontic treatment of trauma-induced necrotic immature teeth using a tricalcium silicate-based bioactive cement. A report of 3 cases with 24-month follow-up |
| Dens invaginatus Type II in an Immature Lateral Incisor With Apical Periodontitis Treated With Regenerative and Strategic Antimicrobial Procedures: A Case Report |
| Personalized Cell Therapy for Pulpitis Using Autologous Dental Pulp Stem Cells and Leukocyte Platelet-rich Fibrin: A Case Report |
| The Management of Open Apex Using a Bioactive Material: A Case Report |
| Apexogenesis of a symptomatic molar with calcium enriched mixture |
| Direct pulp capping of carious immature tooth using bioactive material: A case report |
| Outcome of Regenerative Endodontic Treatment for an Avulsed Immature Permanent Tooth: A Case Report |
| Maturogenesis of a cariously exposed immature permanent tooth using MTA for direct pulp capping: a case report |
| Application of Hyperpure Chlorine Dioxide for Regenerative Endodontic Treatment of a Root-Canal-Treated Immature Tooth with External Cervical Resorption and Periapical Lesion: A Case Report |
| Long-Term Outcome of Nonvital Immature Permanent Teeth Treated With Apexification and Corono-Radicular Adhesive Restoration: A Case Series |
| Impacted stapler pin in fractured maxillary central incisor with open apex: Advanced endodontic management using biodentine as innovative apical matrix |
| Indian journal of public health research & development, may 2020, vol. 11, no. 05 341 use of biodentinetm for vital pulp therapy in children: Three case reports |
| Use of biodentinetm for vital pulp therapy in children: Three case reports |
| Modified Apexification Procedure for Immature Permanent Teeth with a Necrotic Pulp/Apical Periodontitis: A Case Series |
| Revitalization of an Immature Permanent Mandibular Molar with a Necrotic Pulp Using Platelet-Rich Fibrin: A Case Report |
| Mineral trioxide aggregate as a pulpotomy agent in immature teeth: Long-term case report |
| Regenerative Endodontic Therapy in a Single Visit Using Platelet-rich Plasma and Biodentine in Necrotic and Asymptomatic Immature Molar Teeth: A Report of 3 Cases |
| Biodentine (TM) Full Pulpotomy in Mature Permanent Teeth with Irreversible Pulpitis and Apical Periodontitis |
| Regenerative Endodontic Procedures of Immature Permanent Premolars with Periapical Lesions: A Report of Two Cases Using Two Different Materials, 18-Month Follow-Up |
| Retrospective Analysis on Treatment Modalities for Non-Vital Open Apex Cases |
| Conservative approach of a symptomatic carious immature permanent tooth using a tricalcium silicate cement (Biodentine): a case report |
| Pulpotomy for teeth with irreversible pulpitis in immature permanent teeth: a retrospective case series study |
| Mature teeth or primary teeth (26) | Evaluation of Complete Pulpotomy With Biodentine on Mature Permanent Molars With Signs and Symptoms of Symptomatic Irreversible Pulpitis: 12-months Follow-up |
| To Compare the Effectiveness of Biodentine versus Mineral Trioxide aggregate as Direct Pulp Capping agent in carious exposed permanent tooth |
| Outcomes of Vital Pulp Therapy Using Mineral Trioxide Aggregate or Biodentine: a Prospective Randomized Clinical Trial |
| Pulpotomy in primary molars using Ferric Sulphate, MTA, Biodentine and Anti-oxidant drug |
| Primary Teeth Pulp Capping Material |
| Evaluation of Pro root-MTA, Biodentine and Theracal in partial pulpotomy of human dental healthy pulp |
| Capping carious exposures in adults: a randomized controlled trial investigating mineral trioxide aggregate versus calcium hydroxide |
| Factors affecting the outcomes of direct pulp capping using Biodentine |
| Partial Versus Complete Pulpotomy Using Three Different Materials in Primary Molars: a Clinical Study |
| A Clinical Trial Comparing FS With ZOE and Non-eugenol Based Materials in Primary Teeth Pulpotomies |
| Clinical and Radiographic Outcomes of Partial Pulpotomy Procedure in Primary Molars Utilizing Different Capping Materials and Different Restorative Methods |
| Comparative Evaluation of Three Pulpotomy Agents for Permanent Mature Molars With Irreversible Pulpitis |
| TheraCal LC Coronal Pulpotomy and MTA Coronal Pulpotomy in Mature Permanent Molars |
| Comparative evaluation of complete and partial pulpotomy in mature permanent teeth with symptomatic irreversible pulpitis: a randomized clinical trial |
| Current and potential pulp therapies for primary and young permanent teeth |
| A Histopathological Comparison of Pulpal Response to Chitra-CPC and Formocresol used as Pulpotomy Agents in Primary Teeth: A Clinical Trial |
| Influence of occlusal and proximal caries on the outcome of full pulpotomy in permanent mandibular molar teeth with partial irreversible pulpitis: A prospective study |
| Association between concentration of active MMP-9 in pulpal blood and pulpotomy outcome in permanent mature teeth with irreversible pulpitis—a preliminary study |
| Comparative evaluation of treatment outcome of partial pulpotomy using different agents in permanent teeth-a randomized controlled trial |
| The effect of two different contemporary chelating agents on vital pulp therapy in mature permanent teeth with irreversible pulpitis using bioceramic material: randomized clinical trial |
| 4-Year Follow-up of Full Pulpotomy in Symptomatic Mature Permanent Teeth with Carious Pulp Exposure Using a Stainproof Calcium Silicate-based Material |
| Outcome of full pulpotomy in mature permanent molars using 3 calcium silicate-based materials: a parallel, double blind, randomized controlled trial |
| Partial Pulpotomy in Mature Permanent Teeth with Clinical Signs Indicative of Irreversible Pulpitis: a Randomized Clinical Trial |
| Long-term Pulpal and Restorative Outcomes of Pulpotomy in Mature Permanent Teeth |
| Biodentine™ Full Pulpotomy in Mature Permanent Teeth with Irreversible Pulpitis and Apical Periodontitis |
| (Efficacy and radiology evaluation of pulpotomy in mature permanent teeth) |
| Non-vital pulp (7) | Clinical and radiographic evaluation of Biodentine and Mineral Trioxide Aggregate in revascularization of non-vital immature permanent anterior teeth (randomized clinical study) |
| Prognosis of non-vital incisors after apexification using bioceramics: a retrospective study |
| Present status and future directions: Hydraulic materials for endodontic use |
| Evaluation of Biodentine and Mineral Trioxide Aggregate in Revascularization of Non Vital Immature Anterior Teeth |
| Revascularization of Non-Vital, Immature, Permanent Teeth with Two Bioceramic Cements: A Randomized Controlled Trial |
| Modified single-step apexification and strengthening of thin dentinal walls with Biodentine |
| Regenerative Endodontics as the Future Treatment of Immature Permanent Teeth |
| Not Biodentine (46) | Clinical and Radiographic Assessments of Potassium Nitrate in Polycarboxylate Versus Mineral Trioxide Aggregate as Pulpotomy Biomaterials in Immature Mandibular First Permanent Molars: a Randomized Clinical Trial |
| Histological evaluation of pulp response to Syrian crude propolis as a pulpotomy agent in primary and immature permanent teeth—*In vivo* study |
| A Randomised Clinical Radiological Study using Platelet Rich Fibrin and MTA in Pulpotomy of First Permanent Immature Molars |
| Outcome of Regenerative Endodontic Procedures in Nonvital Immature Permanent Teeth Using 2 Intracanal Medications: A Prospective Randomized Clinical Study |
| Regenerative endodontics procedure of an immature permanent mandibular molar with a necrotic pulp using biodentine: a 16 months radiographic follow-up |
| One-year results of vital pulp therapy in permanent molars with irreversible pulpitis: an ongoing multicenter, randomized, non-inferiority clinical trial |
| Dental Pulp Response to RetroMTA after Partial Pulpotomy in Permanent Human Teeth |
| A prospective clinical study of mineral trioxide aggregate for partial pulpotomy in cariously exposed permanent teeth |
| Descriptive Study of Perioperative Analgesic Medications Associated With General Anesthesia for Dental Rehabilitation of Children |
| Efficacy of Erbium, Chromium-doped: yttrium, Scandium, Gallium, and Garnet Laser Irradiation Combined with Resin-based Tricalcium Silicate and Calcium Hydroxide on Direct Pulp Capping: a Randomized Clinical Trial |
| Evaluation of a new bioceramic as pulp capping agent in permanent and immature permanent tooth pulpotomies |
| A Comparison of Single Vs Multiple visit Regeneration Therapy, on different platforms |
| Comparision of different scaffolds for success of regeneration in immature apex |
| A clinical trial comparing different materials in treatment invloving incompletely formed teeth |
| MTA pulpotomy of human permanent molars with irreversible pulpitis |
| Effectiveness of Three Agents in Pulpotomy Treatment of Permanent Molars with Incomplete Root Development: a Randomized Controlled Trial |
| Comparison of mineral trioxide aggregate and calcium hydroxide as pulpotomy agents in young permanent teeth (apexogenesis) |
| Comparative Evaluation of Three Different Materials: Mineral Trioxide Aggregate, Triple Antibiotic Paste, and Abscess Remedy on Apical Development of Vital Young Permanent Teeth |
| Use of mineral trioxide aggregate (MTA) by postgraduates in restorative dentistry in the UK |
| Clinical and radiographic evaluation of vital pulp therapy in open apex teeth with MTA and ZOE |
| Induction of Root Development and Apical Closure in Permanent Mandibular Molar with Irreversible Pulpitis through Total Pulpotomy with Application of Mineral Trioxide Aggregate |
| Comparison of CaOH with MTA for Direct Pulp Capping: A PBRN Randomized Clinical Trial |
| A randomized controlled trial of various MTA materials for partial pulpotomy in permanent teeth |
| MTA *vs* CEM Pulpotomy in Young Permanent Molars |
| The Use of Platelet-Rich Fibrin in Partial Pulpotomy Procedure |
| Vital Pulp Therapy With Different Materials for Young Permanent Teeth |
| Evaluation Of Different Pulpotomy Agents Used For Treatment Of Immature Molars |
| Three Dimensional Evaluation of Apexogenesis of Immature Young Permanent Teeth With Different Endodontic Material |
| Treatment Outcome of Ortho MTA (BioMTA®) Cement *vs* AH Plus® Bioceramic Sealer (Dentsply) |
| Evaluation of Conservative Management of Teeth With Deep Cavitated Carious Lesions |
| Pulpotomy in caries-exposed immature permanent molars using calcium-enriched mixture cement or mineral trioxide aggregate: a randomized clinical trial |
| Partial Pulpotomy in Immature Permanent Molars After Carious Exposures Using Different Hemorrhage Control and Capping Materials |
| Clinical evaluation of efficacy of two kinds of pulp-capping on partial pulpotomy in young permanent incisors |
| Contemporary perspectives on vital pulp therapy: views from the endodontists and pediatric dentists |
| Clinical and radiographic assessments of potassium nitrate in polycarboxylate versus mineral trioxide aggregate as pulpotomy biomaterials in immature mandibular first permanent molars—An original research |
| Effect of chlorhexidine gluconate as hemostatic agent in healing and repair after mineral trioxide aggregate vital pulp therapy in young permanent teeth—A clinical study |
| Should pulp chamber pulpotomy be seen as a permanent treatment? Some preliminary thoughts |
| Maturogenesis of an Immature Dens Evaginatus Nonvital Premolar with an Apically Placed Bioceramic Material (EndoSequence Root Repair Material®): An Unexpected Finding |
| Pulpotomy of Immature Permanent Teeth using Two Different Sealing Materials: A Comparative Study |
| Outcomes of partial pulpotomized immature permanent teeth using mineral trioxide aggregate and acemannan based on clinical evaluation and 3-dimensional radiology |
| Vital pulp therapy with new materials: New directions and treatment perspectives—Permanent teeth |
| The effect of partial pulpotomy with iRoot BP Plus in traumatized immature permanent teeth: a randomized prospective controlled trial |
| Combination effects of diode laser and resin-modified tricalcium silicate on direct pulp capping treatment of caries exposures in permanent teeth: a randomized clinical trial |
| Clinical influencing factors of vital pulp therapy on pulpitis permanent teeth with 2 calcium silicate-based materials: A randomized clinical trial |
| Clinical influencing factors of vital pulp therapy on pulpitis permanent teeth with 2 calcium silicate-based materials: A randomized clinical trial |
| Outcomes of partial pulpotomy in permanent molars of children with irreversible pulpitis: A prospective cohort study |
| Not English (1) | Apexificação em Dentes Imaturos: Revisão Narrativa |
| Not RCT (including studies with no control group) (6) | Deep caries and pulp exposures management preferences in permanent teeth: A survey amongst Spanish dentists |
| The management of deep carious lesions and the exposed pulp in fully developed and immature teeth with irreversible pulpitis: a questionnaire-based study among Greek dentists |
| Full Pulpotomy with Biodentine in Symptomatic Young Permanent Teeth with Carious Exposure |
| Biodentine Pulpotomies on Permanent Traumatized Teeth with Complicated Crown Fractures |
| Study of the Compatibility of New Biomaterials in Vital Pulp Therapy in Pediatric Dentistry |
| Vital pulp therapy in cariously exposed permanent teeth and its limitations |
| Retrospective study (6) | A long-term retrospective clinical study on MTA pulpotomies in immature permanent incisors with complicated crown fractures |
| Correlation between pulp sensibility and magnetic resonance signal intensity following regenerative endodontic procedures in mature necrotic teeth—a retrospective cohort study |
| Immature permanent incisors with complicated crown fractures treated with partial pulpotomy using white mineral trioxide aggregate and IRoot BP plus—a retrospective long-term study |
| Treatment Outcome Following Direct Pulp Capping Using Bioceramic Materials in Mature Permanent Teeth with Carious Exposure: A Pilot Retrospective Study |
| Follow-up of patients subjected to direct and indirect pulp capping of young permanent teeth. A retrospective study |
| Evaluation of photobiomodulation for postoperative discomfort following laser-assisted vital pulp therapy in immature teeth: A preliminary retrospective study |
| Review (27) | Mineral Trioxide Aggregate Apexogenesis: A Systematic Review |
| Biodentine or Mineral Trioxide Aggregate as Direct Pulp Capping Material in Mature Permanent Teeth with Carious Exposure? A Systematic Review and Meta-analysis |
| Clinical applications of hydraulic calcium silicate-based biomaterials in paediatric endodontics |
| Outcome of pulpotomy in permanent teeth with irreversible pulpitis: a systematic review and meta-analysis |
| Role of TheraCal LC in pediatric dentistry: A narrative review |
| Influence of Complicated Crown Fracture on Permanent Teeth Pulp Vitality/Sensitivity: Literature Review |
| Partial Pulpotomy in Young Permanent Teeth: A Systematic Review and Meta-Analysis |
| Use of scaffolds and regenerative materials for the treatment of immature necrotic permanent teeth with periapical lesion: Umbrella review |
| The Mineral Trioxide Aggregate in Vital Pulp Therapy of Permanent Teeth—A Systematic Review |
| Materials for pulpotomy in immature permanent teeth: a systematic review and meta-analysis |
| Toward a Putative Paradigm Shift in Direct Pulp Capping? |
| Comparative efficacy of materials used in patients undergoing pulpotomy or direct pulp capping in carious teeth: A systematic review and meta-analysis |
| Alkaline Materials and Regenerative Endodontics: A Review |
| Successful rehabilitation of traumatized immature teeth by different vital pulp therapies in pediatric patients: A case series and literature review |
| Regenerative endodontic procedures: a review of the literature and a case report of an immature central incisor |
| Vital pulp treatment for traumatized permanent teeth: A systematic review |
| Wound Lavage in Studies on Vital Pulp Therapy of Permanent Teeth with Carious Exposures: A Qualitative Systematic Review |
| Pulp Therapy in Young Permanent Dentition: A Systematic Review |
| Mineral Trioxide Aggregate: A Comprehensive Literature Review-Part III: Clinical Applications, Drawbacks, and Mechanism of Action |
| A Comparison of Selected Regenerative Materials Used in the Management of Pulp Diseases—Review of the Literature |
| Evaluation of the Treatment Protocols in the Management of Pulpally Involved Young Permanent Teeth in Children: A Systematic Review and Meta-analysis |
| Success rate of permanent teeth pulpotomy using bioactive materials: A systematic review and meta-analysis of randomized clinical trials |
| Deep dentine caries management of immature permanent posterior teeth with vital pulp: A systematic review and meta-analysis |
| Mineral trioxide aggregate and other bioactive endodontic cements: an updated overview—part II: other clinical applications and complications |
| Not retrieved (11) | latest procedures to save a fractured rotten permanent front tooth which is otherwise indicated for surgery |
| Comparing the effect of three new materials for the treatment of deep cavities |
| Assessment of treatment after performing therapy on immature permanent teeth with dental materials that have a stimulatory effect on pulp |
| A study for evaluation of the result after treating milk teeth and permanent teeth with dental materials having stimulatory effect on pulp |
| Vital Pulp Therapy in Carious Teeth With Hypomineralization |
| Treatment of Immature Permanent Teeth With Three Different Pulp Capping Materials With Partial Pulpotomy |
| Pulpotomy Technique Preserving Vitality of Traumatized Anterior Permanent Immature Teeth |
| Biodentine Vital Pulpotomy in Immature Molars |
| Effectiveness of Pulpotomy in Carious First Permanent Molar |
| Outcomes of Direct Pulp Capping Using Either ProRoot MTAÂ® or Biodentineâ?¢ in Permanent Teeth With Carious Pulp Exposure in 6–18-year-old Patients |
| Biodentine and MTA in pulp preservation treatment |
| Total excluded studies (194) | |