NCT number:

Title of the study

CLINICAL EVALUATION AND ANTIMICROBIAL EFFECT OF PAPAIN BASED CHEMO-MECHANICAL CARIES REMOVAL AGENTS IN YOUNG PERMANENT MOLARS (A RANDOMIZED CONTROLLED CLINICAL TRIAL)

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Keywords: Minimally invasive, Young Permanent, Chemo-mechanical caries removal agents, Brix 3000.

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   Guidance of the student throughout the thesis progress and revision of the thesis.

2. **Prof. Dalia Mamdouh Talaat**

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3. **Assoc. Prof. Azza Mohamed Said Zakria**

   Supervision of the microbiological assessment and revision of the thesis

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ABSTRACT

Background: Minimally invasive dentistry continues to gain importance, especially in the treatment of permanent teeth with deep caries lesions and immature roots. Chemo-mechanical caries removal (CMCR) is an alternative to the conventional method and consists of the application of a proteolytic substance that softens carious dentin tissue and facilitates its removal using manual instruments. This method can be employed without the use of local anesthesia or burs, thereby preserving sound dental tissue.

Objective: To assess the clinical performance of Brix 3ooo and Papacarie duo gel as chemo-mechanical caries removal agents (CMCR), their performance in terms of time required for the caries removal, patient subjective pain reaction, their radiographic success and their antimicrobial effect in comparison with Atraumatic Restorative Treatment (ART) hand excavation method for caries removal.

Methods: 100 children with age ranging between 8 and 10 years old who have at least one carious first permanent molar will be randomly divided into three groups. A three-arm randomized clinical trial where test groups, group I, caries removal will be using Brix 3000, and group II Papacarie duo will be used, while the control group hand excavation will be the method of caries removal. Dentin samples of three groups will be taken prior to and following caries removal. The total viable streptococci and lactobacilli count will be determined and expressed as colony forming units per milliliter (CFU). The time required for caries removal with each method will be calculated and the subjective pain reaction following each method will be recorded. After complete caries removal step, it will be followed by restoration with glass ionomer restoration**.** Patients will be followed up at 3-, 6- and 12-month intervals to determine the clinical success and at 6- and 12- month intervals for the radiographic success rate for each caries removal method.

Results: The data collected will be statistically evaluated with the suitable tests and tabulated.

Keywords: Minimally invasive, Young Permanent, Chemo-mechanical caries removal agents, Brix 3000.

INTRODUCTION

Over the past 100 years, dentistry has matured from the original tenets of GV Black by moving from 'extension for prevention' to prevention of extension" paradigm following extensive research in cariology and material sciences.[1] Minimally invasive dentistry (MID) is the modern medical approach to the management of caries, utilizing caries risk assessment, and focusing on the early prevention and interception of disease. Moving the focus away from the restoration of teeth allows the dentist to achieve maximum intervention, with minimal invasive treatments. [2]

Minimally invasive dentistry is a philosophy that integrates prevention, remineralization, and minimal intervention for the placement of restorations, thus reaching the treatment objective using the least invasive surgical approach with minimal removal of healthy tissues. In every field of dentistry awareness regarding the importance of preserving tooth tissue is becoming evident.[3] Selective carious tissue removal (incomplete/partial) is suitable for treating deep carious lesions in teeth with vital, asymptomatic pulps. In the periphery of a cavity, removal to hard dentin is performed, while in the pulpo-proximal areas, leathery dentin is left to avoid pulp exposure.[4] A study among children and adolescents found the main causes of phobia to be pain, local anesthesia, and noise from rotating instruments during dental treatment. Such phobia was responsible for the avoidance of dental visits.[5] In addition, the drilling method has a disadvantage in the large amount of tooth removal due to elimination of the sound dentin.[6, 7] Therefore, alternative methods of conventional caries therapy were introduced for the purpose of minimal invasion without causing pain.

The shortcomings of the conventional techniques as well as the introduction of the minimal invasive dentistry propelled the emergence of alternative more selective techniques to increase children comfort such as: air abrasion, air polishing, ultrasonic instrumentation, sonoabrasion, lasers but they are expensive, and hence less frequently used.

Patients' discomfort can be reduced by choosing a technique such as Atraumatic Restorative Treatment (ART).[8] This technique combines hand instrument caries excavation followed by restoration with adhesive restorative materials (typically glass ionomer). Therefore, it avoids the unnecessary use of rotary instruments and local anesthesia, reducing distress, anxiety, and fear for patients.[9] It has been suggested that ART restorations have similar survival rates when compared with conventional restorations,[10, 11] although other investigations call into question the quality of the current evidence.[12, 13] Regardless, ART continues to be adapted and incorporated globally in caries management regimens.[14]

Chemo–mechanical caries removal (CMCR) was the first such method introduced in 1975 by Habib et al. and used 5% sodium hypochlorite.[15] Chemo-mechanical elimination of carious dentin is a promising alternative treatment procedure.[16] CMCR agents are either sodium hypochlorite based such as Carisolv™ or Papain based such as Papacarie duo and the newly developed Brix 3000.[17] Unlike the traditional rotary method, CMCR does not cause heat, pressure, and vibration. Consequently, there is no pain and local anesthesia is not required. Therefore, it is effective for children and adolescents, especially those with dental phobia.[18]

The idea of CMCR was developed in 1970s by Goldman while using sodium hypochlorite (NaOCl) in removing organic materials in the root canals. This chemical has the ability to dissolve carious dentin which makes the decayed

tissue even softer, facilitating its removal with hand instruments hence enhancing the ART approach [19], and since then, the idea of removing caries chemically was born.[20, 21] NaOCl, however, was very unstable and too corrosive in nature when applied on healthy tissue. Hence, they decided to incorporate it into Sorensen's buffer (which contains glycine, sodium chloride (NaCl) and sodium hydroxide (NaOH)) in an attempt to minimize this problem.[22]

In 2003, Papacarie duo was introduced unlike already present CMCR agent Carisolv™ there is no need for a special equipment to apply, and it is cheaper. Its active ingredient was papain enzyme in a concentration of 6000 U/mg and chloramine as antimicrobial agent. Papain is a naturally occurring proteolytic enzyme that consists of the pulp of the fruit, leaves, and rubber of the Carica papaya tree, which is grown in tropical regions such as Brazil, India, South Africa, and Hawaii. It is similar to human pepsin and has bactericidal, bacteriostatic, and anti-inflammatory properties.[17] With its antibacterial effect, it can prevent the proliferation of both Gram negative and Gram-positive organisms. Papain also acts as an anti-inflammatory, debriding agent that does not damage healthy tissue and accelerates the cicatricle process. Chloramines, which are amines containing at least one chlorine atom bonded directly to a nitrogen atom, are formed during the reaction between chlorine and ammonia. They have bactericidal and disinfecting properties and are used chemically to soften carious dentin.[23]

El-Tekeya et al.,(2012)[16] evaluated effectiveness of Carisolv™ and Papacarie duo on residual cariogenic bacteria in dentin of primary teeth in comparison to hand excavation. There was a statistically significant difference between Papacarie duo and both Carisolv™ and hand excavation methods, with Papacarie duo being more effective in caries removal and causing more reduction in bacterial count. Boob et al., (2014)[24] conducted a study to compare the effectiveness of caries removal in permanent teeth by three

minimally invasive methods (Papacarie duo, Carisolv™ and hand excavation). It was concluded that the effectiveness of CMCR techniques is better than hand method in terms of dentin preservation so the chances of maintaining vitality of the pulp would be enhanced, moreover Papacarie duo showed better effectiveness than Carisolv™.

The most recent modification made on papain-based gels was the introduction of Brix 3000. It was introduced to the market in 2017 with major differences in composition. It presents a high papain concentration (30,000 U/mg) with toluidine blue as an antimicrobial agent and contains no chloramine and has been suggested to have better anti-inflammatory properties, which may favor the recovery of pulp tissue. Its main ingredient is papain, that is bioencapsulated and immobilized in the patented gel in a concentration of 30,000 U/mg using Encapsulating Buffer Emulsion technology (EBE).[25] This would give the gel an ideal pH to ensure that the enzymes are able to perform a proteolysis on the collagen of decayed dental tissue, better resistance to unfavorable storage environment, and greater antimicrobial properties.[26] The higher concentration of papain together with toluidine blue create a synergistic effect and facilitate the removal of caries. Furthermore, this formulation contains no chloramines, which enhances its toxicological safety feature.[27]

Alkhouli et al 2020 [28] evaluated the effectiveness of a 2.25 % sodium hypochlorite gel and Brix 3000 as a CMCR agent compared to each other based on the time needed and patient acceptance of caries removal from primary teeth clinically, compared to the conventional methodology of rotary instrumentation. They concluded that Brix 3000 and 2.25 % sodium hypochlorite gel are CMCR agents that are effective in removing of carious dentin of primary teeth without affecting children's cooperation.

However, conventional drilling technique is much faster in the excavation of caries. Duman et al 2021 [29] compared Brix 3000 gel and polymer bur in terms of time spent on caries removal, patient acceptability, and clinical success in immature permanent molars. They found that the use of a CMCR agent or polymer bur is recommended as a solution for the treatment of patients seeking an alternative to conventional methods.

Additionally, these methods may serve as an interim treatment during the apexogenesis process in the management of immature permanent teeth with deep caries. Another advantage of these methods is that, since they do not involve water cooling, they can also minimize the risk of contamination and cross infection.[29]

Heading out of the contradictory results, no publication has reported the in vivo comparison between Papacarie duo and the newly developed CMCR agent Brix 3000 gel in terms of their clinical and radiographic success and their antimicrobial effect compared to the Art approach for caries removal in young immature permanent teeth. The null hypothesis of this study is that no statistically significant difference will be detected between both materials and ART approach regarding to their clinical performance, and their antimicrobial effect in young permanent molars during the follow up period.

AIM OF THE STUDY

Primary aim

- To assess and compare the effectiveness of two chemo-mechanical agents Brix 3000 and Papacarie duo in terms of their clinical and radiographic success in young permanent molars, in comparison with ART approach.

Secondary aims

- Determine the required time for complete caries removal for each method.
- Evaluation of patients' subjective pain reactions following each method.
- Evaluation of antimicrobial effect of two chemo-mechanical caries removal agents by comparing the colony forming units (CFU) at the treatment visit before and after the application of each agent compared to hand excavation method.

MATERIALS AND METHODS

Study design

This will be a randomized, parallel, three-arms controlled clinical trial, with a 1:1:1 allocation ratio. It will be set up and reported according to the CONSORT guidelines. [30]

The PICOT question is:

Will children (8-10 years old) with class I carious lesion in the first permanent first molar (with ICDAS score 5 or 6) (population; P) using Brix 3000 or Papacarie duo gel (intervention; I) for Chemo-mechanical caries removal in comparison with ART approach (Hand excavation) (Control; C) show a greater success (outcome; O) at different time intervals over twelve months period (time; T)?

Study setting and location

The study will take place in the Department of Pediatric Dentistry and Dental Public Health at the Faculty of Dentistry and the Department of Microbiology and Immunology at the Faculty of Pharmacy, Alexandria University, Alexandria, Egypt.

Sample

Sample size estimation

The sample size was estimated assuming a 5% alpha error and 80% study power. The overall success rate after 1 year was 95% for chemo-mechanical caries removal,[31] whereas it was 67% for traditional caries removal.[32] Based on the difference between independent proportions, the sample size was calculated to be 30 patients per group, increasing to 36 patients to make up for lost follow-up cases. Total sample = number per group x number of groups = 36 x 3 = 108 patients.

Software

The sample size was based on Rosner's method[33] calculated by G*Power 3.1.9.7. [34]

Eligibility criteria

The participants enrolled in this study will be selected after fulfilling the following criteria:

Inclusion Criteria

- Healthy children aged 8-10 years old.
- The presence of at least one deep carious class 1 lesion in the first permanent molar with a score of 5 or 6 according to the International Detection and Assessment System (ICDAS), detected by visual-tactile inspection to assess lesion severity. [35] (APPENDIX I, Tables 1)

Exclusion criteria

- Children reporting spontaneous or elicited pain from caries or showing any signs of pulpal infection, swelling or abscess.
- Pulpal exposure or bleeding during the excavation procedure
- Children presenting with special health care needs or undergoing medical treatment for chronic or acute diseases affecting salivary flow.
- Allergy or sensitivity to any of the materials included in the study.

Randomization technique and allocation[36]

- Subjects complying with the inclusion criteria will be randomly assigned to one of the treatment groups, using a computer-generated list of random numbers to either the Brix 3000, Papacarie duo gel group (www.random.org) or ART approach (Hand excavation).
- Allocation will be performed by a trial independent individual and the allocation ratio is intended to be equal (1:1:1).

Allocation concealment[37]

An assistant will be responsible for giving each participant a serial number that will be used for his/her allocation. A duplicate of this number will be kept in an opaque envelope indicating to which group the patient belongs. This envelope will be kept by a trial independent individual who will be assigned the role of opening it only at the time of intervention; so that the group to which the child is allocated is concealed from the investigator. Grouping Participants will be randomly and equally allocated to one of the three treatment groups:

Grouping

Participants will be randomly and equally allocated to one of the three treatment groups:

- Test group I (Brix 3000): 36 children meeting the eligibility criteria will be treated using Brix 3000.
- Test group II (Papacarie duo gel): 36 children meeting the eligibility criteria will be treated using Papacarie duo gel.
- Control group: 36 children will be treated using ART approach (Hand excavation).

Blinding[38]

The investigator will not be blinded to the treatment type. However, the participants, the statistician, and the microbiologist will be blinded to the treatment group.

Materials

- BRIX 3000 gel. *
- Papacarie duo gel. **
- EQUIA Forte HT FIL glass ionomer capsules. ***

Materials for the microbiological assessment

- Mitis Salivarius Bacitracin (MSB) agar (selective culture media for S. mutans) prepared according* to the manufacturer's instructions. ****
- Rogosa SL agar plates (selective culture media for lactobacilli), prepared according to the manufacturer's instructions. *****
- Saline as a transport medium.
- Sterile test tubes.
- Sterile plastic Petri dishes.
- Anaerobic gas jar.
- Incubator. ******

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* Brix Medical Science. Carcaraña, Santa Fe, Argentina.
** F&A Laboratório Farmacéutico Ltda, São Paulo, Brazil.
*** GC CORPORATION 76-1 Hasunma-cho, Itabashi-ku, Tokyo 174-8585, Japan.
**** Difco Laboratories Inc, NJ, USA.
***** Himedia Laboratories, Mumbai, India.
****** Red line by binder.

Method

Training and calibration

The main researcher will be trained and calibrated by the study supervisors regarding the use of ICDAS criteria[35] in the diagnosis of the teeth to be included in the study, as well as application of both test materials.

Intra-examiner reliability [39]

The examination of 10 selected children between 8 to 10 years of age will be carried out followed by re-examination after seven days for the determination of intra-examiner agreement measured by Cohen's Kappa (K). Obtaining a Kappa score ≥ 0.8 is considered excellent reliability. These children will not be included in the study sample.

Baseline examination

- After obtaining the informed consent from the caregiver/parent, (APPENDIX II) the researcher will provide oral hygiene instructions to each of the study participants and will inform them about the importance of maintaining good oral hygiene and a proper diet guidance. [40]
- All the examinations and interventions will be done by one calibrated examiner.
- Periapical x-ray radiographs will be taken for each tooth before enrolling it into the trial to determine that the carious lesion depth does not involve the pulp.

Intervention

- All the lesions in the children's oral cavity indicated for treatment will be treated and sampled for microbiological analysis prior to and following caries removal.
- On the day of the intervention, the children will be asked to refrain from tooth brushing in the morning, as well as eating and drinking (except water) for at least two hours before the appointment.[41]

- The patients will be instructed to rinse with a cup of water, then the outer surface of the carious lesion will be washed with a flurry of water to avoid contamination of plaque bacteria. [42]
- The tooth will then be partially isolated using cotton rolls and saliva ejector.
- Two portions of dentin will be collected with sterile excavators from the middle of the cavity to perform the microbiological analysis of each tooth before and then after caries removal procedure. [41]
- The dentin sample will then be inserted in a sterile test tube containing 1 mL of saline and transported to the microbiology laboratory within 1-2 hours. [43]
- Dentin sample weight will be calculated by measuring the difference between the weight of the whole set (sterilized bottle and transporting medium) and the previously determined weight of the set without dentin. [44]
- The bacterial count obtained for a given amount of dentin will be used to estimate the number of colonies present in 1 mg dentin (CFU/mg). [44]
- **In the CMCR group:** either Papacarie duo or Brix 3000 gel will be applied on the carious lesion of tooth and left undisturbed for 30-60 seconds, following manufacturer instructions [28]. This produces softening of carious dentin, which will be removed with a hand excavator. This step will be repeated 2-3 times until dentin demonstrates slight resistance with no tug-back sensation when tested with an exploratory probe while pressing an explorer into dentin, then the application of the chemo-mechanical agents will be stopped.
- The visual test for assessment of complete caries excavation will be based on non-turbid appearance of the CMCR agent used.
- **In the ART group** hand excavation will be performed to remove the carious tissue from the cavity by using a sterile sharp hand excavator. The cavity will be determined to be caries-free according to visual and tactile clinical criteria.
- No local anesthesia will be administered as it would alter the pain perception of the patient unless necessary.

Evaluations

1. Clinical evaluation

- The clinical assessment will be at 3-, 6- and 12-month intervals to evaluate
  a) Postoperative pain
  b) Any signs or symptoms of pulpitis
  c) Vertical and horizontal percussion tests
  d) Tooth-color alterations and fistulas presence.
  e) Restoration success will be evaluated according to the criteria of atraumatic restorative treatment by Phantumvanit et al. (1996) (45). It is based on the retention of the material in the cavity and the presence of secondary caries.
  f) Restorations which will receive a score of 0, 1 or 7 will be considered successful while those having a score of 2, 3, 4 or 8 will be considered failures. Those which will receive a score of 5, 6 will be excluded from the analysis (Appendix IV).

2. Radiographic evaluation

- Periapical radiograph will be taken immediately after clinical procedure and at 6- and 12-months intervals during follow up period to confirm the clinical evaluation.[46]
- It will be obtained by the long cone paralleling technique to minimize the distortion using the film holders. [47]
- The radiographic evaluation will be performed using the radiographic subtraction method and the assessment of the density of the remaining dentin by gray-scale analysis using the Image j 1.37 V program [31].
- Therefore, a greater degree of density on the image will indicate a greater success.

- Any case that will exhibit pulp involvement associated with a radiolucent image or any signs for periapical lesions will be considered unsuccessful treatments.

3. Evaluation of time required to perform procedure

- The time needed for complete caries removal will be recorded for each caries removal method.
- The timing of each procedure will set immediately upon the first application by using a stopwatch and turned off when there is no carious dentin left in the cavity.
- After complete removal of decay, the teeth will be restored with glass ionomer filling as a temporary restoration to be replaced after the follow up period using Composite filling sandwich technique.

4. The participants' pain assessment:

- Subjective pain will be assessed after caries removal by means of Wong-Baker faces scale [(48)]. It consists of faces with different facial expression for happiness and pain and is scored from 0-5 as 0 is very happy and feels no pain and 5 is very painful (APPENDIX III).
- Each child will be trained to use the scale by first modeling and then asking each participant to think of the last time she/he felt something painful' and to select the facial expression that best represented his/her experience of discomfort.

5. Microbiological evaluation Procedure

- Samples from the carious lesion will be collected prior to and following complete caries removal for detection of the change in bacterial count (Streptococci and Lactobacilli counts).

a. Sample dilution

All samples will be dispersed by vortexing for 30 seconds then 10-fold serially diluted using sterile saline. A measure of the dilution will then be used for traditional plate culturing methods. (49)

b. Culture

Aliquots of 10 ml of each dilution will be inoculated into freshly prepared Rogosa agar media using a micropipette.

- Mitis Salivarius agar plates will be incubated anaerobically in an atmosphere containing 10% CO2 at 37°C for 72 hours to detect Streptococcus mutans count
- Rogosa agar plates will be incubated aerobically at 37° C for 48 hours to detect Lactobacilli count.

c. Isolation and Enumeration

Following the predetermined incubation period, colonies grown on the specified media will be counted and represented as (CFU/ml). Streptococcus mutans will be identified based on their characteristic morphology on Mitis Salivarius agar plates. Similarly, Lactobacilli will be identified biochemically and microscopically on the basis of their morphology.

Colony count

The number of colonies will be determined and expressed as colony forming units using the following equation. (50)

$$\text{CFU/ml} = \frac{\text{n° of colonies} \times \text{dilution factor}}{\text{Volume taken in ml}} \quad (51)$$

6. Oral Health quality of life questionnaire

- Oral health quality of life will be assessed at one week recall appointment by using the Arabic validated version of the child perceptions questionnaire. [52]
- It consists of 25 items distributed among 4 domains: oral symptoms, functional limitations, emotional well-being, and social well-being. It is self-reported by children using a 5-point Likert scale (APPENDIX V), and responses range from 0–4 for each item. Hence, total scores range from 0 to100, and higher scores indicate poorer OHRQoL. (APPENDIX VI)

STUDY OUTCOME

Treatment effect will be evaluated after the follow up period by comparing:

1- Clinical effectiveness of each material during the follow up period at 3-, 6- and 12-months intervals confirmed with radiographic findings at 6- and 12-month intervals.
2- Timing required for complete caries removal following each caries removal method
3- Participants' subjective pain reaction following each caries removal method.
4- Antimicrobial effect of both CMCR agents by comparing the colony forming units (CFU) at the treatment visit before and after application of each agent compared to conventional caries removal method.

Follow up

All patients will be recalled after 3-, 6- and 12-month intervals. On the day of the recall appointment, patient preparation will be done as mentioned before.

Outcome assessment

1- Restorations which will receive a score of 0, 1 or 7 will be considered successful while those having a score of 2, 3, 4 or 8 will be considered failures.
2- Any clinical sign and symptoms teeth with pain, intraoral or extra oral abscess formation and fistula formation will be recorded as unsuccessful treatments
3- Any periapical lesions on radiography during follow-up will be recorded as unsuccessful treatments.

Study Plan

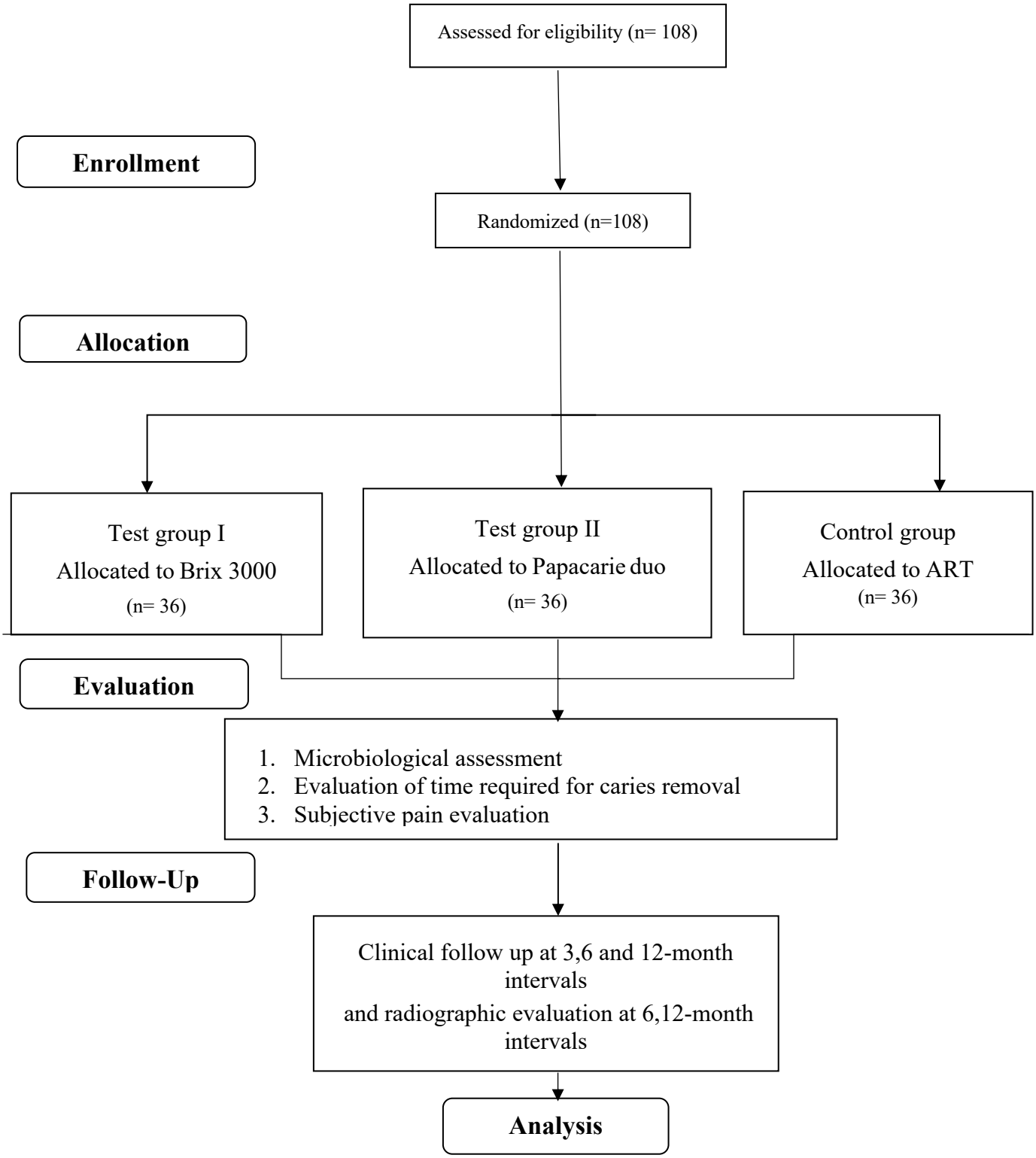

Figure 1: Flow chart of the study plan

STATISTICAL ANALYSIS

The statistical Package for Social Sciences (SPSS)* version 27.0 for Windows will be used for data analysis.

All data will be collected; The Chi square test will be used to compare the difference between the three groups regarding the clinical success, the T-test or the Mann-Whitney U test will be used to analyze the differences between the microbiological samples. The data will be graphically presented with suitable graphs. The level of statistical significance will be set at 5%.

* SPSS Inc., Chicago, IL, USA

ETHICAL CONSIDERATIONS

1. The research protocol will be approved by the Research Ethics Committee of Alexandria University Faculty of Dentistry (IRB No. 001056 –IORG 0008839) prior to any research-related activities.
2. All research activities involving human subjects will abide by the Declaration of Helsinki[53] and other ethical guidelines adopted by the Research Ethics Committee of Alexandria University Faculty of Dentistry.
3. Benefits:
   - It will provide caries treatment for young permanent molars in children using minimally invasive atraumatic procedures.
   - It will allow overcoming the disadvantages of conventional treatment with local anesthesia
   - Support the use of chemo-mechanical caries removal agents as a more convenient substitute conventional method for caries removal.
4. Harms/Risks: Nothing.
5. Privacy and confidentiality:

   Each participant will be provided with a serial number that will only be accessible to the principal investigator. No data regarding the identity of the participants will be shared under any circumstances. All participants or their guardians must provide a written informed consent prior to any procedures.

DURATION OF THE STUDY

Estimated time: 17 Months.

Tasks \ Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Purchase material	✓																
Patient recruitment		✓	✓														
Treatment procedures			✓	✓													
Evaluations																	
1. Clinical and radiographic success of the CMCR				✓	✓	✓	✓	✓	✓	✓	✓	✓					
2. Time required for caries removal				✓													
3. Subjective pain assessment following each method				✓													
4. Microbiological assessment				✓													
5. OHRQL questionnaire				✓													
Data management and statistical analysis													✓				
Writing thesis														✓	✓	✓	
Thesis submission																	✓

ESTIMATED BUDGET

Estimated total budget: 45,000 LE

No	Materials	Total price (LE)
1	Materials	20000
2	Microbiological assessment	15000
3	Statistical analysis	2000
4	Computer services	2000
5	Printing services	2000
6	Publication cost	3000
7	Others	1000
Total		45000

PROBLEMS ANTICIPATED

The main problems facing the study are:

1- The expenses of used materials.

2- The recruitment of patients.

3- The microbiological assessment procedures.

PUBLICATION POLICY

This study will be sent for either national or international journals for publications.

The order of name will be:

1. Passant Hamed Metwally Hassanein
2. Prof. Abdel Wahab Samaha
3. Prof. Dalia Mamdouh Talaat
4. Assoc. Prof. Azza Mohamed Said Zakria

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APPENDIX I

Table (1): ICDAS severity criteria[54]

Score	Criteria
0	No change in enamel translucency with prolonged air drying
1	First visual change in enamel (after prolonged air drying)
2	Distinct visual change in enamel
3	Localized enamel breakdown or discolored enamel with no visible dentin involvement
4	Underlying dark shadow from dentin
5	Distinct cavity with visible dentin
6	Extensive distinct cavity with visible dentin

APPENDIX II

Arabic translated informed consent.

APPENDIX III

Figure (2): Wong-Baker FACES Pain Rating Scale

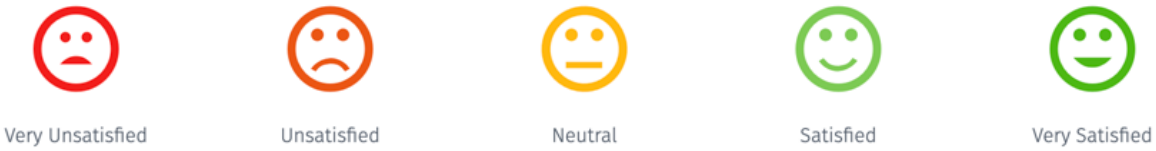
APPENDIX IV

Table (2): Evaluation scores criteria of atraumatic restorative treatment proposed by Phantumvanit.[45]

Codes	*Description*
0	Present, in good condition
1	Present, slight marginal defect, no repair needed
2	Present, marginal defects 0.5-1.0 mm, repair needed
3	Present, marginal defects > 1.0 mm, repair needed
4	Not present, restoration partially or completely missing
5	Not present, restoration replaced by other restoration
6	Tooth missing, exfoliated or extracted
7	Present, slight wear, no repair needed
8	Present, wear > 0.5 mm, repair needed

APPENDIX V

Figure (3): showing 5-points Likert scale



APPENDIX VI

Table (3) Arabic validated version of the child perceptions questionnaire(52)