EVALUATION OF SUSTAINABILITY OF MECHANICAL PROPERTIES OF POLYPROPYLENE SUTURE MATERIALS EXPOSED IN CHLORINE DIOXIDE MOUTHWASH USED IN POST PERIODONTAL SURGERIES

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ABSTRACT

INTRODUCTION

Periodontal surgeries are done to eliminate periodontal pockets and to correct the mucogingival defects. Success of the periodontal therapy depends upon many factors and one of the important factors is the suture and the suture materials. In oral and periodontal surgery, sutures are routinely used for wound closure and wound approximation.

MATERIALS AND METHODS

Polypropylene sutures are taken for this study of size 4-0 and 5-0 about 10 cm in length and are classified into 2 groups. Group1- polypropylene 4-0 and 5-0 control , Group 2- polypropylene 4-0 and 5-0 sutures with chlorine dioxide mouthwash were used.

RESULTS AND DISCUSSION:

Results shows tensile strength of 4-0 suture was higher compared to 5-0. Change in tensile strength could be influenced by many factors. Firstly, the oral environment has a permanent presence of saliva, gingival crevicular fluid, high tissue vascularization; which comes in direct contact with the sutures that may alter the physical properties of the suture material in turn altering the tensile strength.

CONCLUSION

In conclusion, the evaluation of the sustainability of mechanical properties of polypropylene suture materials exposed to chlorine dioxide mouthwash post-periodontal surgeries is pivotal for advancing both clinical practices and material science in healthcare.

KEYWORDS: Polypropylene sutures, Periodontal surgery, Chlorine dioxide mouthwash

INTRODUCTION

Periodontal surgeries are done to eliminate periodontal pockets and to correct the mucogingival defects. Success of the periodontal therapy depends upon many factors and one of the important factors is the suture and the suture materials. In oral and periodontal surgery, sutures are routinely used for wound closure and wound approximation. (1) There are various classifications for sutures. They can be natural or synthetic, depending on the raw material used. They can be either monofilament or multifilament, depending on the structure. They can be divided into absorbable and non-absorbable groups based on their capacity for resorption and degeneration. Saliva, oral fluids, and serum do not dissolve non-absorbable sutures. Furthermore, in order to remove them, a second appointment is needed. Since hydrolysis and proteolytic enzymes break down absorbable sutures, their removal is not necessary.(2)

In order to achieve healing through primary intention, the flaps are sutured into close approximation after the surgical procedure and left there for a predetermined amount of time. When flaps are positioned incorrectly, the secondary intention of healing takes place, potentially compromising the outcome.(3) The perfect suture material must possess a number of unique qualities, including sufficient tensile strength, the ability to elongate in the presence of tissue edema, biocompatibility, ease of manipulation, the ability to maintain a tight knot, and the ability to biodegrade if used in internal wound closures.(4) Tensile strength and percentage elongation are the two most crucial intrinsic qualities of a suture material to have in order to keep the surgical flaps in place during the wound healing process.(5)

Consuming different kinds of food and beverages will inevitably cause the pH and temperature in the oral cavity to vary significantly. (6) The use of preventive products like mouthwash and toothpaste contributes to this variability as well. In the oral cavity, different suture materials display unique properties and soft tissue reactions. Inflammatory reactions brought on by the suture materials themselves may cause delayed healing. Thus, among the many suture materials available, tissue response to these materials is one of the most important considerations when selecting the appropriate material.
The aim of the study is to evaluate the sustainability of tensile strength of polypropylene suture materials in patients undergoing flap surgery.

MATERIALS AND METHOD

Study design

The study design includes a parallelized controlled clinical trial for which the study subjects were recruited from the patients reporting to the Out-patient department of periodontics, with the following inclusion and exclusion criteria.

Inclusion criteria

Age >18 years, Systematically healthy, Subjects willing to give consent form,Patients diagnosed with Periodontitis having pockets in at least 1 or more areas who are indicated for periodontal flap surgery for pocket management.

Exclusion criteria

Smoking more than 10 cigarettes per day, Contraindications for periodontal surgery., Taking medications known to interfere with periodontal tissue health and healing, Previous periodontal surgery, After clearance from the Institutional Ethical Committee,

A total of fourteen subjects satisfied the inclusion and exclusion criteria, who were explained about the purpose, risks, benefits, of the procedures and the study and after obtaining the informed consent the subjects were finally included in the study. The age of the study population ranged from 20 - 45 years, in which 8 were males and 6 were females, indicated for periodontal flap surgery. The study subjects were then allocated to one of the two study groups.

Study group

Group I: Periodontitis with 4-0, 5-0 polypropylene suture (control group).

Group II: Periodontitis with 4-0, 5-0 polypropylene suture with chlorine dioxide mouthwash (Test group).

Subjects in the groups II were initiated with phase I periodontal therapy which included complete scaling and root planing. Complete oral-hygiene instructions

were advised. The periodontal flap surgery was planned 3 weeks after the phase I therapy if adequate oral hygiene was seen during re-evaluation. The tensile strength was measured prior to Surgery (baseline) and during follow up (7th day).

Assessment of sustainability

Baseline assessment

One inch of the suture material before suturing the site was cut and used as a baseline sample for the assessing

tensile strength.

Surgical procedure and postoperative protocol

All surgeries were performed by the same periodontist and the same suturing technique (continuous sling) was used in all the cases, under total asepsis and adequate local anesthesia

(Lignocaine-1:200000) at the surgical site. After mechanical debridement, the flap was approximated using continuous sling suturing technique with surgeons knotted in the groups II Polypropylene 4-0 and 5-0 sutures and postoperatively, patientswere instructed to take analgesic (Aceclofenac 100mg, BID, as needed for pain), use antimicrobial rinse (0.12% chlorhexidine, twice daily for 2 weeks) for plaque control, and avoid any mechanical plaque control for 2 weeks. Sutures were removed at 7 days postoperatively. The removed suture material was transported to the lab in Ringer's Lactate (RL) solution.

Mechanical testing method

Each sample was prepared with an acrylic knob holding the material in the form of a knot and this is placed around two metal poles installed in the Universal Testing Machine (INSTRON E 3000 UTM at a crosshead speed of 10mm/unit - Instron Industrial Products, 900 Liberty Street, Grove City, PA 16127, USA) with a fixed distance of 15.0 mm between the two poles. The tensile strengths of the suture samples were tested at specific times: baseline and post-treatment suture removal on 7th day. The study was carried out in a heavy duty testing lab in Saveetha dental college that is specialized in evaluating tensile strengths. Tensile strength (TS) was measured on a tensile meter in a unit of Newton (N) in the universal testing machine. TS is the force applied per unit original cross-sectional area, to a test specimen at any given time. Each sample was stretched until the material failed, and the maximum load was recorded in Newtons (N).

RESULTS:

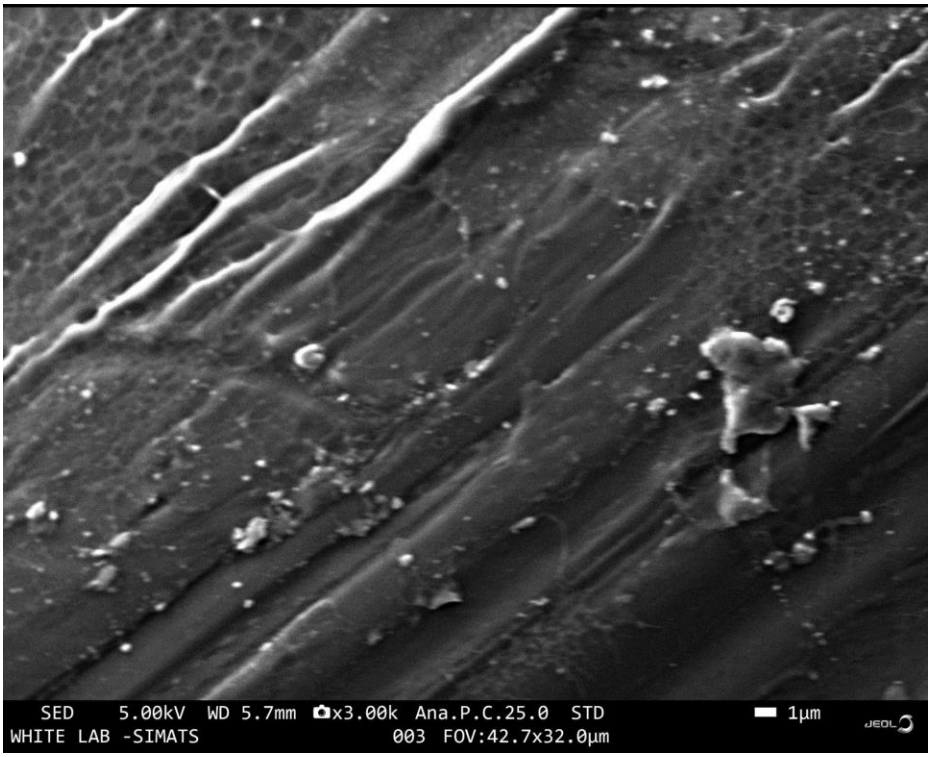

Fig 1: SEM image of polypropylene suture control

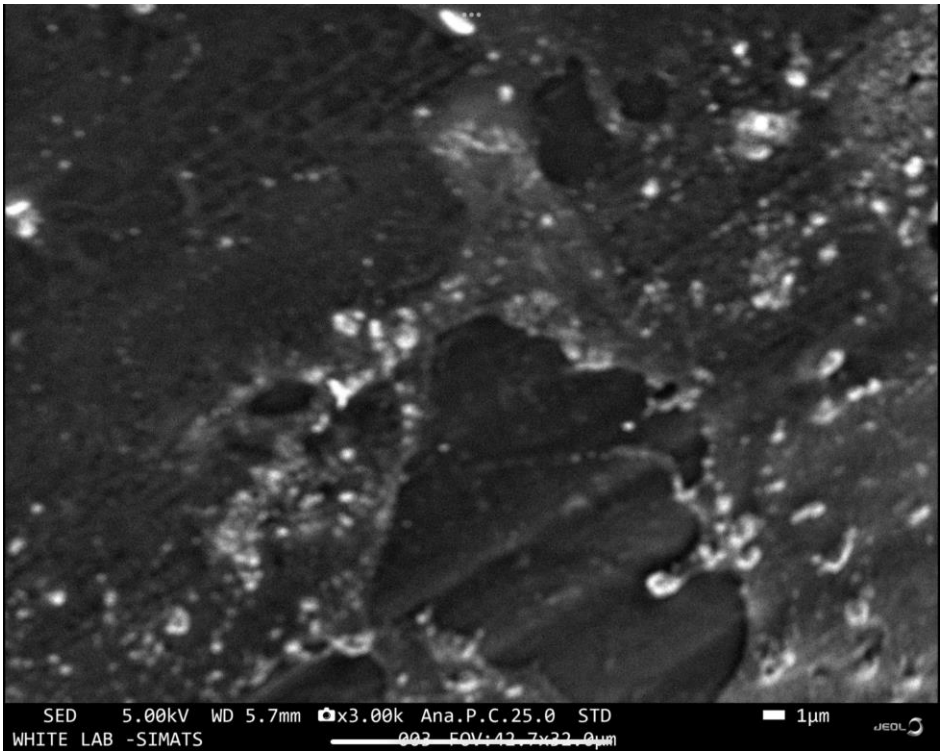

Fig 2: SEM image of polypropylene suture test

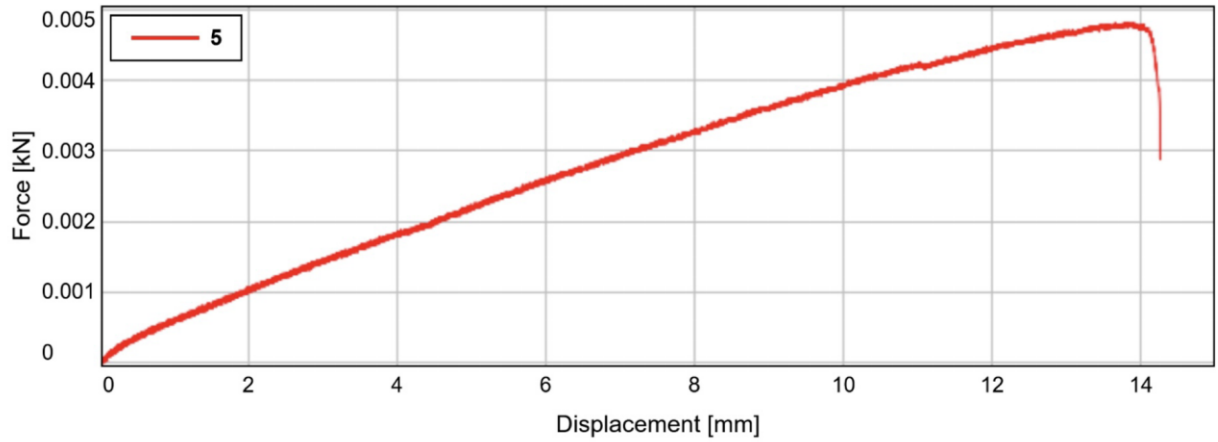

Fig 3: Graph shows the polypropylene suture 5-0 test

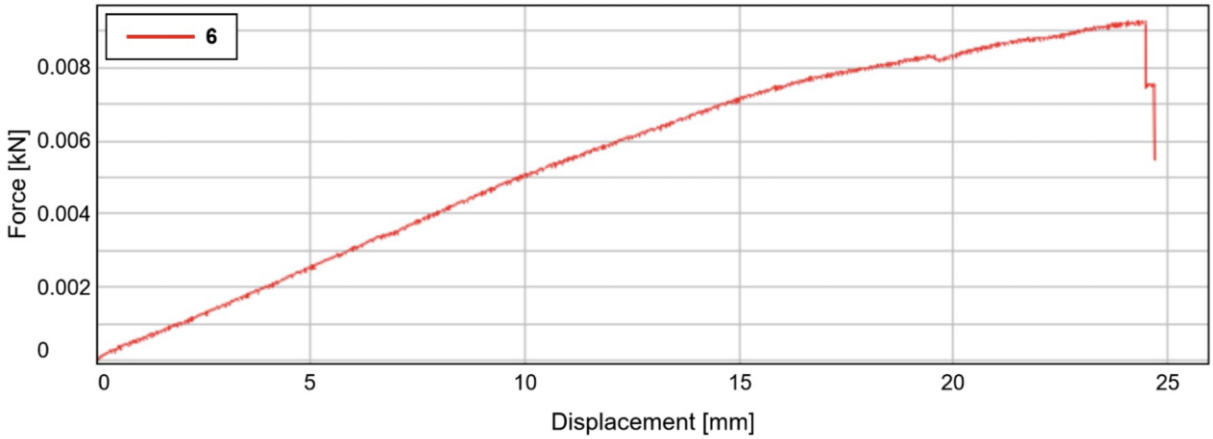

Fig 4: Graph shows the polypropylene suture 4-0 test

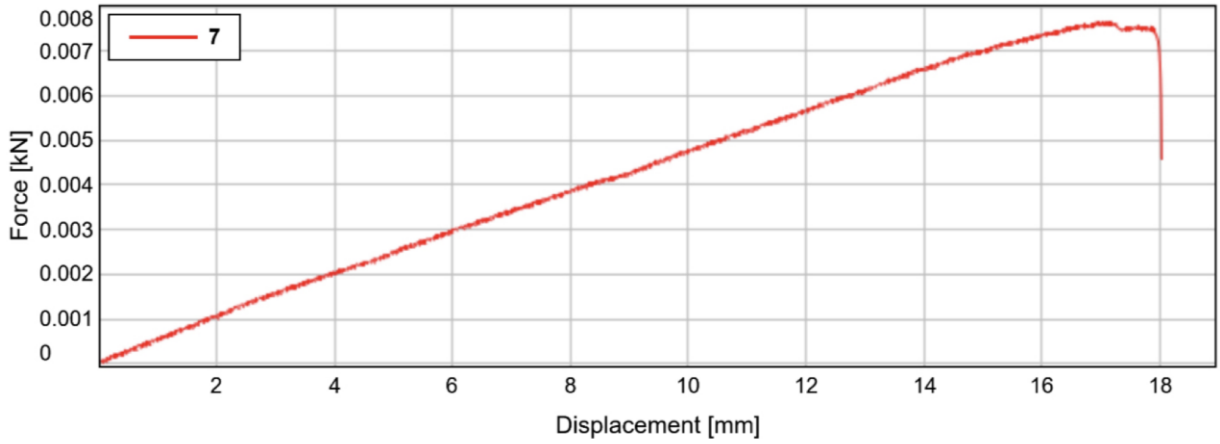

Fig 5: Graph shows the polypropylene suture 4-0 control

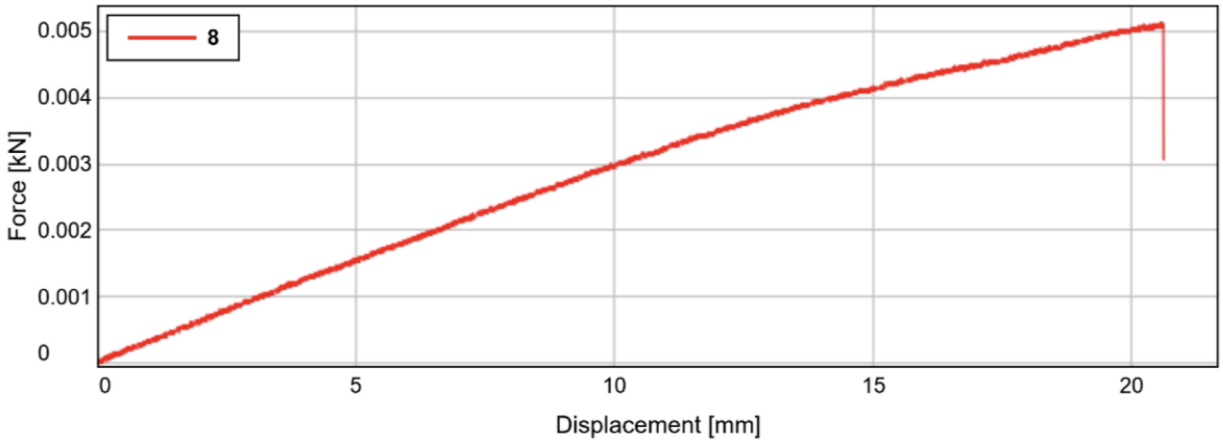

Fig 6: Graph shows the polypropylene suture 5-0 control

DISCUSSION:

Results shows tensile strength of 4-0 suture was higher compared to 5-0. Change in tensile strength could be influenced by many factors. Firstly, the oral environment has a permanent presence of saliva, gingival crevicular fluid, high tissue vascularization; which comes in direct contact with the sutures that may alter the physical properties of the suture material in turn altering the tensile strength.

The exposure of polypropylene suture materials to chlorine dioxide mouthwash may affect their integrity. It's essential to consider the potential impact on material properties, such as strength and durability, when exposed to chemical agents like chlorine dioxide. (7) Incorporating polypropylene sutures in medical procedures demands a thorough understanding of their compatibility with various substances, including chlorine dioxide mouthwash.(8) Research into the potential effects on the suture's molecular structure, tensile strength, and overall performance is crucial for ensuring the safety and efficacy of medical interventions involving these materials. Such investigations contribute to the broader dialogue on material compatibility and may influence best practices in medical settings.(9) Understanding the interaction between polypropylene sutures and chlorine dioxide mouthwash is vital for healthcare practitioners. Research should delve into how the chemical exposure might alter the suture's biomechanical properties and whether any changes could compromise its effectiveness in wound closure.(10) This knowledge not only aids in refining surgical techniques but also contributes to advancements in suture material development, promoting patient safety and optimal clinical outcomes. The exposure of polypropylene suture materials to chlorine dioxide mouthwash post-periodontal surgery warrants careful consideration.(11) Research into how this chemical interaction may impact wound healing, tissue response, and potential complications is essential. Understanding the compatibility of polypropylene sutures with postoperative care, such as the use of mouthwash, is crucial for ensuring successful outcomes in periodontal surgeries.(12) This information could guide clinicians in optimizing patient care protocols and contribute to the ongoing enhancement of postoperative

practices in periodontal procedures(13). Examining the effects of chlorine dioxide mouthwash on polypropylene sutures post-periodontal surgery involves assessing factors like tissue irritation, suture degradation, and overall healing outcomes(14) Research in this context is pivotal for tailoring postoperative care strategies, minimizing potential complications, and enhancing the success of periodontal interventions(15). The findings may not only influence clinical protocols but also contribute to refining material choices in dental surgeries, promoting patient well-being and optimizing the overall post-surgery experience.

CONCLUSION

In conclusion, the evaluation of the sustainability of mechanical properties of polypropylene suture materials exposed to chlorine dioxide mouthwash post-periodontal surgeries is pivotal for advancing both clinical practices and material science in healthcare. This evaluation not only addresses the immediate concerns associated with post-periodontal surgery but also underscores the importance of sustainability in healthcare. By understanding how suture materials withstand chemical exposures, we move toward more resilient and enduring solutions, reducing the need for frequent replacements and ultimately improving patient outcomes.

CONFLICT OF INTEREST:

No conflict of interest declared

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REFERENCE

1. PRESIDENT IP. Edited by: Dr. K. Nandakumar, Hon. Editor• Published By: Dr. OV Sanal, Hon Secretary• For IDA, Kerala State Branch• Production: Suman Graphics, sumangf x@ gmail. com.
2. Sharon E, Polak D, Sharon S, Beyth N. Wound Dressing in the Oral Cavity. Biofilm, Pilonidal Cysts and Sinuses. 2020:55-68.
3. Kühn KD. Antimicrobial implant coating. Biofunctional Surface Engineering; Scholz, M., Ed.; Pan Stanford Publishing: Singapore. 2014 Feb 21:121-89.
4. Rao J. QRS for BDS 4th Year-E-Book: Oral and Maxillofacial Surgery. Elsevier Health Sciences; 2014 Sep 25.

5. Oshida Y, Farzin-Nia F. Response of Ti–Ni alloys for dental biomaterials to conditions in the mouth. InShape Memory Alloys for Biomedical Applications 2009 Jan 1 (pp. 101-149). Woodhead Publishing.
6. Morimoto T, Hirata H, Eto S, Hashimoto A, Kii S, Kobayashi T, Tsukamoto M, Yoshihara T, Toda Y, Mawatari M. Development of silver-containing hydroxyapatite-coated antimicrobial implants for orthopaedic and spinal surgery. Medicina. 2022 Apr 6;58(4):519.
7. Pachtinger G, Levittown PA. ER Life-Saving Procedures.
8. Mishra R, Verma A, Rai S, Singh AP, Singh SP, Nigam S. Advances in endodontics a complete guide. Book Rivers; 2022 Apr 19.
9. Abourehab MA, Pramanik S, Abdelgawad MA, Abualsoud BM, Kadi A, Ansari MJ, Deepak A. Recent advances of chitosan formulations in biomedical applications. International journal of molecular sciences. 2022 Sep 19;23(18):10975.
10. Pavithra R. *Knowledge, Attitude and Practice Regarding Infection Control Measures Among Dental Students in a Dental Institute, Bangalore* (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).
11. Gallo M, Naviglio D, Caruso AA, Ferrara L. Applications of chitosan as a functional food. InNovel approaches of nanotechnology in food 2016 Jan 1 (pp. 425-464). Academic Press.
12. Gatti AM, Montanari S. Advances in Nanopathology: From Vaccines to Food. CRC Press; 2021 Apr 28.
13. Vlaminck L. *Triazolinedione building blocks: their sustainable synthesis and macromolecular implementation* (Doctoral dissertation, Ghent University).
14. Rashid R, Sartori M, White LE, Villa MT, Yoo SS, Alam M. Breaking strength of barbed polypropylene sutures: rater-blinded, controlled comparison with non barbed sutures of various calibers. Archives of dermatology. 2007 Jul 1;143(7):869-72.
15. Faulkner BC, Tribble CG, Thacker JG, Rodeheaver GT, Edlich RF. Knot performance of polypropylene sutures. Journal of Biomedical Materials Research: An Official Journal of The Society for Biomaterials and The Japanese Society for Biomaterials. 1996 Sep;33(3):187-92.