Evaluation of Sustainability of Mechanical Properties of polypropylene Suture Materials exposed to chlorhexidine mouthwash during post operative Periodontal care

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ABSTRACT:

INTRODUCTION: Mechanical properties of suture materials play an important role in clinical outcomes of periodontal surgery, thus any changes in these properties might influence the surgical wound healing. As there are various factors that can alter the physical and mechanical properties of suture materials when present in the oral cavity, sustainability of the properties is of much importance. **AIM**: The aim of this study is to evaluate the sustainability of tensile strength of polypropylene suture materials in patients undergoing periodontal flap surgery. **MATERIALS**: A total of fourteen subjects who were indicated for surgical periodontal pocket management were included in this study. After Random allocation, Group1- polypropylene 4-0 and 5-0 control , Group 2- polypropylene 4-0 and 5-0 sutures with chlorhexidine mouth wash were used. The Tensile strength of suture material was evaluated before and after surgery. **RESULTS**: 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.

Keywords: Mechanical Properties, polypropylene Suture Materials, chlorhexidine mouthwash

INTRODUCTION

In oral and periodontal surgical treatments, sutures are routinely utilized for wound closure and wound approximation. The Egyptians were the first to record the use of linen as a suture material around 3500 BC. Wound closures have been effectively achieved by the use of animal hair, vegetable fibers, silk, leather, and gut as suture materials (1). Polymers make up the majority of sutures. Large molecules known as polymers are composed of monomers, which are repeating units of smaller molecules. There are various classifications for sutures (2). They might be natural or synthetic, depending on the raw material utilized. They can be either monofilament or multifilament, depending on the structure. They are divided into two categories: absorbable and non-absorbable, based on their degenerative capacity (3). Oral fluids, saliva, 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 (4). These materials are constantly being subjected to mechanical stresses from chewing, speaking, making facial expressions, and changing pH, saliva, bacterial proteolytic enzymes, and vascularization levels (5). The capacity of an appropriate suture material to cover wounds for maximum healing with little to no strain is crucial, even if it can be challenging to reduce mechanical forces across suture lines in the oral cavity. Furthermore, a lot of doctors have made an effort to reduce stress by suggesting a liquid or soft diet or limiting talking and chewing while the body heals from surgery (6).

In order to keep surgical wounds' tissue integrity intact, suturing is essential. Ensuring that the sustained approximation of flap margins remains steady over a specific duration is a crucial component of good wound closure (7). This satisfies a favorable treatment outcome and permits a desirable degree of tissue repair. Inability to close a wound properly can cause dehiscence or delayed healing, which can cause problems with function and appearance (8). A monofilament non-absorbable surgical suture, polypropylene suture is made of an isotactic crystalline stereoisomer of the synthetic linear polyolefin polypropylene. It has blue pigment applied to improve visibility (9). Good knot security and easy knot placement, excellent tensile strength, do not exhibit elasticity while knotting which is ideal for knot security, Smooth passage through tissue provides no trauma (10).

However, to the best of our knowledge, no study has compared the strengths of polypropylene suture materials over time when exposed to commercial oral mouth- wash solutions. Therefore, the current study aims to evaluate the tensile strength and breaking point of polypropylene sutures in association with commercial types of mouthwashes (chlorhexidine), an orally simulated environment (artificial saliva) and an immersed dry condition during a two-week period.

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 chlorhexidine 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).

Figure 1: The above picture indicates the measurement of tensile strength polypropylene suture material using Universal Testing Machine.

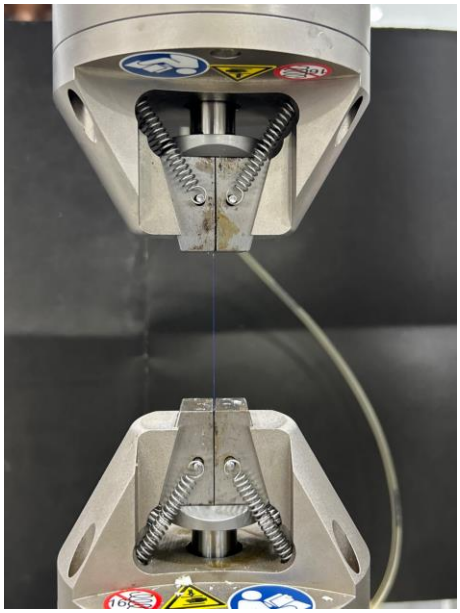

Figure 2: The above picture indicates the measurement of tensile strength polypropylene suture material at 1 week post operatively using Universal Testing Machine.

Statistical analysis: The statistical analysis was performed with the SPSS 12.0 software. First, the univariate analysis was carried out by measuring the central tendency (arithmetic mean) and the measure of dispersion (standard deviation) of the variable tensile strength of the suture materials (4-0 and 5-0). The statistical assumptions of normality and homoscedasticity were then explored using the Shapiro-Wilk test. Finally, the bivariate analysis was performed using the Mann-Whitney and Independent-t tests depending on the values obtained in the previous analysis. Finally, statistical significance achieved was p=0.057.

RESULTS

Specimen label	4-0	5-0
Tensile stress at Break (Standard) [MPa] control group	4.56±1.2	3.82±1.1
Tensile stress at Break (Standard) [MPa] test group	5.95±0.7	4.34±0.5

When analyzing the descriptive statistics, it was found that in relation to both the groups, the average tensile strength was stable between baseline and 1 week post-operative. When making the inference with the Mann-Whitney test, showed that there was statistically significant difference between both groups at 1 week post-operative. When compared between the groups there was a statistically significant difference where polypropylene 4-0 was showing higher sustainability than polypropylene 5-0 . There was no discernible difference in the decrease in tensile strength at 3, 7, 14, and 21 days between polyglactin, black silk, and PTFE in earlier studies.

DISCUSSION

According to earlier research, non-absorbable materials have lower stress resistance, but absorbable materials exhibit stronger resistance. According to Khiste et al., polyglactin (Vicryl) sutures showed little strength by day 14, however they still had their tensile strength until day 10 (11). Vicryl's tensile strength was found to be diminished in saliva as opposed to immersion in other liquids including soy, saline, or milk, according to a different study by Ferguson et al. Chu et al. also found that absorbable sutures performed worse than nonabsorbable sutures when pH levels were high. They went on to explain that absorbable sutures can degrade more quickly in both acidic and alkaline conditions (12). In the meanwhile, Ven Herdeen claims that the only environment that sped up the breakdown of synthetic, or "man-made," absorbable sutures was an alkaline one.

Kearney CM et al examined how various equine physiological and pathological fluids affected the rate at which commonly used suture materials degraded. discovered that multifilament suture materials degrade more quickly than monofilament sutures (13). Numerous factors could have an

impact on the change in tensile strength in both groups. First off, the oral environment is constantly containing saliva, gingival crevicular fluid, and highly vascularized tissue that comes into direct contact with the sutures and may change the material's physical characteristics, which in turn may change the suture's tensile strength (14). Furthermore, during mastication, swallowing, and speech-related activities, it is mechanically manipulated. Second, handling the material during the suturing process may cause some physical damage to the suture thread, which could have a negative effect on the suture's tensile strength. Surprisingly, our results show that both materials' tensile strengths increased after a week, regardless of mechanical and physical handling (15). As a result, it has been demonstrated that both materials maintain qualities that may promote wound healing.

Comparing the tensile strength of non-absorbable monofilament suture materials in the oral cavity has never been done before. The smaller sample size, the fact that the tensile strength was only measured on the seventh postoperative day, the fact that only the surgeon's knot was used to evaluate a single property, and the lack of a standardized method for evaluating the tensile strength are all limitations of our study that may have an impact on the outcomes. Larger sample sizes and additional research are required, keeping in mind the other elements that contribute to the loss of tensile strength. Additional mechanical attributes may be incorporated to provide additional validation of our findings.

CONCLUSION:

From our results it is wise to conclude that the tensile strength of 4-0 suture was higher compared to 5-0, both polypropylene 4-0 and polypropylene 5-0 have retained their tensile strength and 4-0 did sustain better properties throughout the healing period. Hence, 4-0 sutures can be the material of choice for periodontal surgeries involving long healing periods.

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