

How will my introduction of teaching dry toothbrushing and the use of xylitol affect supra-gingival calculus deposits?

An action research paper

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ABSTRACT

Introduction

As a dental hygienist, I have tried different oral hygiene strategies, such as teaching tooth-brushing techniques, flossing, and anti-bacterial rinsing; the methodologies learned while in dental hygiene school to decrease supragingival calculus on the lingual surface of the mandibular anteriors. These strategies have resulted in minimal success in decreasing the amount of calculus formation. This concern has been an ongoing repetitive struggle, leaving both my clients and myself frustrated and disappointed with the lack of success. The information attained about the benefits of dry tooth-brushing and xylitol lead me to my action research question; **How will my introduction of teaching dry tooth-brushing and the use of xylitol affect supragingival calculus deposits?**

Methodology

The modified Bass tooth-brushing method involves sulcular cleaning along with cleaning the coronal portion of the tooth. The modified Bass brushing technique will be implemented with dry tooth-brushing (without the use of toothpaste). The tooth-brushing instructions will include starting the brushing sequence on the mandibular anterior lingual surfaces. After the completion of dry tooth-brushing, my client will complete a second round of tooth-brushing using xylitol toothpaste with the same brushing sequence noted previously. Spry xylitol toothpaste will be used twice a day following the manufacturer's instructions. Spry mints will be used daily to increase the

amount of xylitol exposure, consumed 4 - 5 times a day. The re-evaluation of calculus deposits will be conducted.

Results

Dry tooth-brushing alone decreased the amount of plaque in the oral cavity, consequently decreasing the supragingival calculus deposits. The addition of xylitol to the daily regimen further decreased the bacterial plaque accumulation adding to the reduction of calculus levels. Incorporation of both the dry tooth-brushing and xylitol prove beneficial for improved oral health.

Conclusion

Combining dry tooth-brushing with xylitol use results in a reduction of bacterial plaque and consequently decreases supragingival calculus deposit formation.

INTRODUCTION

Over the past nine years, I have worked as a registered dental hygienist in a general dentistry practice. Throughout my career, I have had clients repeatedly discuss their concern for the amount of supragingival calculus that forms on the lingual surface of the mandibular anteriors. They have expressed their frustration that with flossing and daily brushing they still develop moderate to heavy calculus deposits. As a hygienist, I have tried different oral hygiene strategies in an attempt to eliminate the supragingival calculus deposits on the mandibular lingual surfaces of the anteriors. The oral hygiene strategies used included: teaching tooth-brushing techniques, flossing and anti-bacterial rinsing; the methodologies learned while in dental hygiene school. These strategies have resulted in minimal success in decreasing the amount of calculus formation on the lingual surface of the mandibular anteriors. The concern for the lack of success with assisting my clients with decreasing supragingival calculus hit home when my younger sister, Janelle, also a client of mine, expressed how unhappy she was that her current oral hygiene routine was lacking results in decreasing supragingival deposits. With toothbrushing twice a day, daily flossing and antibacterial rinsing, she was accumulating moderate to heavy supragingival calculus around her permanent retainer on the lingual surface of her mandibular anterior teeth. This concern has been an ongoing repetitive struggle, leaving both my clients and myself frustrated and disappointed with the lack of success. Feeling frustrated and seeking a means to help my clients improve their oral hygiene lead me to think what else could I do as a health care provider. Through recent discussions with colleagues, I have come across two different methodologies that can significantly decrease bacterial plaque biofilm and

calculus formation. Tooth-brushing without the use of dentifrice or toothpaste (dry tooth-brushing) and xylitol both can help decrease bacterial plaque accumulation, which in turn will decrease calculus formation. The information attained lead me to my action research question; **How will my introduction of teaching dry tooth-brushing and the use of xylitol affect supragingival calculus deposits?** As a dental hygienist, I believe we have the ethical and moral responsibility to deliver the utmost care to our clients. I feel that simply providing a 'cleaning' is insufficient and we as a profession need to achieve an elevated level of health for our clients. The client may not like the aesthetics of supragingival calculus; however, as a healthcare provider, I am concerned not only with my client's goals but also with achieving an increase in overall health. A decrease in supragingival calculus will decrease bacterial levels in the mouth and contribute to decreased bacterial levels throughout the body. By testing dry tooth-brushing and xylitol use I am hoping I can provide my clients with a means to increase their oral health status by decreasing supragingival calculus formation.

BACKGROUND

Calculus is commonly referred to as tartar or dental calculus. Calculus is bacterial plaque biofilm that has been mineralized by calcium and phosphate salts in the saliva, gingival crevicular fluid and inflammatory exudate (Darby and Walsh 2010). Calculus is made up of both organic and inorganic components. "Inorganic components make up about 75% to 85% of calculus and include calcium, phosphorous, carbonate, sodium, magnesium, and potassium. Organic components make up about 15% to 25% of the calculus and include nonvital microorganisms, desquamated epithelial cells,

leukocytes, salivary mucins, cholesterol, cholesterol esters, phospholipids, fatty acids, sugars, carbohydrates, keratins, nucleoproteins, and amino acids" (Darby and Walsh 2010, p. 290). Biofilm deposits can begin to mineralize anywhere from 24 hours to 20 days if left undisturbed. Calculus is classified by its location on the tooth surface in relation to the gingival margin (Wilkins 1999). Supragingival calculus is located at or above the gingival margin on the coronal portion of the tooth. "Calculus above the free gingival margin is located most commonly adjacent to the sublingual and parotid salivary gland ducts, resulting in calcified deposits on the mandibular anterior lingual surfaces and maxillary posterior facial surfaces of teeth" (Darby and Walsh 2010, p. 288). "Mandibular lingual surfaces demonstrate greater accumulations of both hard and soft deposits and more bleeding on probing than other areas of the mouth" (O'Hehir, and Suvan 1998, p. 614). Essentially supragingival calculus can be found throughout the oral cavity where oral hygiene is inadequate in removing bacterial plaque deposits prior to mineralization.

The toothbrush is the instrument generally used for accomplishing bacterial plaque removal as part of oral disease control (Wilkins 1999). Tooth-brushing is possibly the most important step an individual can take to reduce bacterial plaque accumulation and plaque-related diseases (Creeth, Gallagher, Sowinski, Bowman, Barrett, Lowe, Patel, and Bosman 2009). Many dental professionals recommend brushing for a minimum of two minutes to effectively remove bacterial plaque accumulation. Several studies have concluded that the average time spent brushing by individuals is approximately forty-five seconds (Creeth, Gallagher, Sowinski, Bowman, Barrett, Lowe, Patel, and Bosman 2009). "As adjuncts to toothbrushing, dentifrices and

rinsing solutions have been proposed, in order to enhance the plaque removal efficacy” (Zanatta, Antoniazzi, Pinto, and Rösing 2012, p. 235 - 240). “The indication for dentifrices is mainly based on the presence of fluoride, antimicrobial agents that aim at further reducing plaque formation and/or removing a previously established plaque. Additionally, dentifrices are associated with a sense of a pleasant flavor and coolness after usage. Dentifrices have also been used as plaque removal aids, especially because of their abrasive agents” (Zanatta, Antoniazzi, Pinto, and Rösing 2012, p. 235-240). The actual role of toothpaste to mechanically remove dental plaque is contradictory (Zanatta, Antoniazzi, Pinto, and Rösing 2012). Toothpaste are readily available and claim to help decrease plaque; however, research has shown that to be inconclusive. Studies conducted comparing plaque removal with toothpaste versus water showed very little difference with added toothpaste. The toothpaste was shown to not help decrease the oral plaque level or assist with an action of tooth-brushing (Creeth, Gallagher, Sowinski, Bowman, Barrett, Lowe, Patel, and Bosman 2009). “The effectiveness of plaque removal during toothbrushing with dentifrices is essentially a function of access of the brush bristles rather than dentifrice abrasive. Plaque removal was, however, not influenced by the presence of dentifrice (over 60 seconds brushing), indicating that dentifrice constituents, such as abrasive and surfactant, do not meaningfully assist the action of the brush” (Creeth; Gallagher; Sowinski; Bowman; Barrett; Lowe; Patel; and Bosma 2009, p. 114-5). “It may be concluded that the use of a conventional dentifrice during toothbrushing does not seem to enhance plaque removal capacity” (Zanatta, Antoniazzi, Pinto, and Rösing 2012, p. 235-240). Brushing with toothpaste creates bubbles, while the flavor numbs your tongue, making your teeth feel clean when in fact

they are not (O'Hehir 2003). Therefore clients should continually be encouraged to brush for a minimum of two minutes to help decrease plaque, but the emphasis should be placed on brushing time and technique versus the addition of toothpaste. The method of brushing without the use of toothpaste is referred to as 'dry tooth-brushing'.

Xylitol has been around for over 100 years (Huber 2004). "Xylitol was discovered in 1891 by chemists Emil Herman Fischer and Rudolf Stahel in Germany and simultaneously in France by chemist M.G. Bertran" (O'Hehir 2012, p.8). Research to investigate the use of xylitol and its effect on preventing cavities was performed in Finland in 1975, the 'Turku Sugar Studies' (xylitolprevents cavities.com). The first dental research investigating the use of xylitol was completed in Finland. Xylitol is a natural occurring sweetener, a sugar alcohol to be exact; that can be found in tree bark, fruit, and vegetables (xylitolcanada.com). "Xylitol is a white crystalline granule that looks and tastes like sugar" (xylitolcanada.com). Xylitol has been shown to help keep a neutral pH in the mouth, interfering with bacteria adhering to teeth, inhibiting bacterial growth and decreasing bacteria by as much as 90% (xylitol.org). "During habitual xylitol consumption, the counts of *Mutans streptococci* decrease and remain on a lower level as long as the consumption lasts" (Söderling 2009, p. 74). Xylitol exposure significantly inhibits biofilm formation (Söderling 2009). The mechanism by which xylitol reduces plaque is probably a decrease in the adhesiveness of plaque, as discussed above (Söderling 2009, p. 76). "After xylitol, the bacteria do not stick well on the surface of the teeth and as a result, the amount of plaque decreases. Dental patients can be encouraged to use xylitol every day to have a decrease in dental bacteria and reduction in caries. The key to getting the greatest benefit from xylitol is to use it consistently and

often, so it stays in contact with your teeth, mouth, and nasal passages. Look for products that encourage chewing or sucking to keep it in contact with your teeth. Xlear and Spry products are sweetened with 100% xylitol" (xlear.com). Studies have shown that the application of xylitol 4 to 5 times a day is effective (xlear.com). Encourage patients to use xylitol five times a day: brushing with 100% xylitol toothpaste at the beginning and end of the day, and using a xylitol gum or candy after each meal" (xylitol.org). Xylitol should also be consumed after snacking between meals. "In the amounts clinically proven to provide amazing oral health benefits (less than 15 grams per day), it is safe for everyone and can be conveniently delivered to your teeth via chewing gum, tablets, toothpaste, mouthwash or even candy" (xlear.com). "Many of the studies have shown that it is important that it be the major or only sweetener in the products because the addition of other sweeteners often reduces the effectiveness of xylitol" (xlear.com).

METHODOLOGY

Prior to implementation of dry tooth-brushing (tooth-brushing without the use of toothpaste) and the use of xylitol, I will be collecting baseline data. The baseline data will include a visual examination to determine calculus deposit location; a calculus index to determine quantitative values of deposit formation (see image A); intraoral photos to show visually the calculus deposit location, and lastly the assessment of the current tooth-brushing technique being utilized.

IMAGE A

Grade	Debris index	Calculus index
0	No debris or stain present	No calculus present
1	Soft debris covering not more than one-third of the tooth surface, or the presence of extrinsic stains without other debris regardless of the tooth surface area covered	Supragingival calculus covering not more than one-third of the exposed tooth surface
2	Soft debris covering more than one-third, but not more than two-thirds, of the exposed tooth surface	Supragingival calculus covering more than one-third, but not more than two-thirds, of the exposed tooth surface, or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth, or both
3	Soft debris covering more than two-thirds the exposed tooth surface	Supragingival calculus covering more than two-thirds of the exposed tooth surface, or a continuous heavy band of subgingival calculus around the cervical portion of the tooth, or both

(www.lookfordiagnosis.com)

Following the collection of the baseline data, I will begin the implementation of dry tooth-brushing and the use of xylitol. The modified Bass tooth-brushing method will be taught. The modified Bass tooth-brushing method involves sulcular cleaning along with cleaning the coronal portion of the tooth. (Wilkins 1999) states that the toothbrush bristles are angled 45 degrees to the gingival margin, allowing the bristles to go subgingival, removing bacterial plaque biofilm. Adding a roll stroke at the end enables bacteria on the coronal portion of the tooth to be effectively removed. With teaching the appropriate brushing technique, the sequence of brushing will also be reviewed. My client, Janelle, will be instructed to start her tooth-brushing sequence on the lower mandibular anterior lingual surface. The instructions with brushing will be as follows: starting the on the mandibular anterior lingual surface the area will be brushed without toothpaste until the area feels clean to the tongue; moving onward she will continue brushing the lingual surfaces of the mandibular teeth (all areas to be brushed until

feeling clean to the tongue); after completion of the lingual surfaces, the mandibular buccal surfaces will be brushed, followed by the maxillary buccal, and finishing with the maxillary lingual surfaces. After the completion of tooth-brushing without toothpaste, she will complete a second round of tooth-brushing using xylitol toothpaste, with the same brushing sequence noted previously. Spry xylitol toothpaste will be used twice a day following the manufacturer's instructions.

Along with the use of the Spry toothpaste, Spry mints will be used daily to increase the amount of xylitol exposure. The mints will be consumed 5 times a day, after each meal and snack.

After the implementation of the dry tooth-brushing method and daily use of xylitol, the calculus deposits will be re-evaluated. The re-evaluation will be comprised of a visual exam to determine the accumulation of deposits on the mandibular anteriors, as well as another index to determine the quantitative amount of deposits, and lastly, intraoral photos depicting the location and amount of deposits present.

GATHERING AND INTERPRETING DATA

The baseline data collected involved a visual intraoral examination, concluding the presence of moderate to heavy supragingival calculus deposits located on the lingual surface of the mandibular anterior teeth. Intraoral photos showing calculus formation and location were taken prior to and after implementation of dry tooth-brushing, and the use xylitol products. Unfortunately, both sets of images were lost due to technical issues with the dental software program. The remainder of the data will be based on the visual intraoral exam, calculus index and client's verbal report on oral

health changes. The first calculus index taken prior to implementation of the dry tooth-brushing and xylitol use resulted in a score of 3 (supragingival calculus covering more than two-thirds of the exposed tooth surface, or a continuous heavy band of subgingival calculus around the cervical portion of the tooth, or both); see IMAGE B.

IMAGE B

Grade	Debris index	Calculus index
0	No debris or stain present	No calculus present
1	Soft debris covering not more than one-third of the tooth surface, or the presence of extrinsic stains without other debris regardless of the tooth surface area covered	Supragingival calculus covering not more than one-third of the exposed tooth surface
2	Soft debris covering more than one-third, but not more than two-thirds, of the exposed tooth surface	Supragingival calculus covering more than one-third, but not more than two-thirds, of the exposed tooth surface, or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth, or both
3	Soft debris covering more than two-thirds the exposed tooth surface	Supragingival calculus covering more than two-thirds of the exposed tooth surface, or a continuous heavy band of subgingival calculus around the cervical portion of the tooth, or booth

Janelle verbalized that her teeth felt dirty and were both dissatisfied and frustrated with the amount of calculus present on the mandibular anteriors prior to dry tooth-brushing and the use of xylitol. She brushes her teeth twice a day using a manual soft toothbrush, sensitive toothpaste and flosses daily. She describes her brushing technique as having no set sequence, however, she often finds herself starting her brushing on the maxillary buccal surfaces, working towards the posterior. After completion of the maxillary buccal surfaces, she proceeds to brush the mandibular buccal surfaces, finishing her brushing on the lingual surfaces, with the mandibular

anteriors being the very last area to be brushed. When asked Janelle verbalized that she estimates she brushes for approximately 30 seconds each time she brushes, using the Fones (circular pattern) brushing technique.

With the implementation of the Modified Bass tooth-brushing method, Janelle found it slightly challenging to be more aware of her brushing sequence and to start on the mandibular anterior lingual surfaces. She did report that with paying more attention she was able to make that adjustment with ease. Dry tooth-brushing and xylitol were implemented at separate appointments, with re-evaluations of both modalities separately. The dry-tooth-brushing technique Janelle reported as feeling slightly weird at first because of the absence of toothpaste. However, with the lack of toothpaste she did state that her teeth felt significantly cleaner to the touch of her tongue immediately. Janelle quickly adjusted to the lack of toothpaste and became accustomed to dry brushing and the feeling of clean teeth that it brought. With each brushing, she verbalized she felt the dry brushing was removing more plaque and her mouth felt cleaner, she was happy with the initial results. At a seven-week follow-up visit, prior to the xylitol implementation, there was a significant decrease in calculus formation on the mandibular anterior lingual surfaces. Minimal deposits were noted on the lingual marginal aspects of the mandibular anterior teeth from lateral incisor to lateral incisor. There was a reduction in the calculus index from a '3' (Supragingival calculus covering more than two-thirds of the exposed tooth surface, or a continuous heavy band of subgingival calculus around the cervical portion of the tooth, or both) to an index score of '1' (Supragingival calculus covering not more than one-third of the exposed tooth surface); see IMAGE C.

IMAGE C

Grade	Debris index	Calculus index
0	No debris or stain present	No calculus present
1	Soft debris covering not more than one-third of the tooth surface, or the presence of extrinsic stains without other debris regardless of the tooth surface area covered	Supragingival calculus covering not more than one-third of the exposed tooth surface
2	Soft debris covering more than one-third, but not more than two-thirds, of the exposed tooth surface	Supragingival calculus covering more than one-third, but not more than two-thirds, of the exposed tooth surface, or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth, or both
3	Soft debris covering more than two-thirds the exposed tooth surface	Supragingival calculus covering more than two-thirds of the exposed tooth surface, or a continuous heavy band of subgingival calculus around the cervical portion of the tooth, or both

Janelle was extremely pleased with the results. Since she was now comfortable with the technique of dry brushing, starting on the mandibular lingual surfaces, we implemented the daily xylitol usage. Janelle was provided with the xylitol products; Spry toothpaste, and Spry mints (Cinnamon flavor), the instructions for use (mints consumed after each meal and snack, 4 - 5 times a day), and lastly booked for a 3 week re-evaluation appointment. Janelle reported dry tooth-brushing prior to brushing morning and night with the Spry toothpaste. She verbalized that she consumed the xylitol mints after each meal and snack, resulting in at least 4 - 5 mints per day. With the addition of xylitol she felt her breath was fresher, there was fewer bacteria present and less plaque build-up during the day. She feels as though the combination of the dry tooth-brushing with the xylitol created the best feeling and resulted in a decrease in calculus deposits. The toothpaste left her mouth feeling fresh, as well as clean, and the addition of the mints made her mouth feel even cleaner than with the toothpaste alone. The intraoral

exam revealed very scanty supragingival calculus located on 2 interproximal surfaces of the mandibular incisors; 31 mesial and 41 mesial, both on the lingual surface. The calculus deposit location on the interproximal surface indicates flossing technique adjustments that can be made and not an indication of technique error with the dry tooth-brushing and xylitol use. The final calculus index score was taken resulting in a score of '1' (Supragingival calculus covering not more than one-third of the exposed tooth surface); see IMAGE D.

IMAGE D

Grade	Debris index	Calculus index
0	No debris or stain present	No calculus present
1	Soft debris covering not more than one-third of the tooth surface, or the presence of extrinsic stains without other debris regardless of the tooth surface area covered	Supragingival calculus covering not more than one-third of the exposed tooth surface
2	Soft debris covering more than one-third, but not more than two-thirds, of the exposed tooth surface	Supragingival calculus covering more than one-third, but not more than two-thirds, of the exposed tooth surface, or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth, or both
3	Soft debris covering more than two-thirds the exposed tooth surface	Supragingival calculus covering more than two-thirds of the exposed tooth surface, or a continuous heavy band of subgingival calculus around the cervical portion of the tooth, or booth

Although the calculus index reported the same numerical findings with both the dry tooth-brushing as it did with the xylitol use, clinically the decrease in amount and location of the deposits could be observed.

MAIN FINDINGS/RESULTS

Dry tooth-brushing alone drastically decreased the amount of plaque in the oral cavity, consequently decreasing the supragingival calculus deposits. The calculus index improved from a score of '3' (Supragingival calculus covering more than two-thirds of the exposed tooth surface, or a continuous heavy band of subgingival calculus around the cervical portion of the tooth, or both) to a final score of '1' (Supragingival calculus covering not more than one-third of the exposed tooth surface); indicating a significant decrease in calculus deposit formation. The addition of xylitol to the daily regimen further decreased the bacterial plaque accumulation adding to the reduction of calculus levels. Incorporation of both the dry tooth-brushing and xylitol prove beneficial for improved oral health. The oral cavity has a decreased biofilm environment, leaving the mouth feeling cleaner. With the client reporting her teeth feeling drastically cleaner with the use of dry tooth-brushing and xylitol, resulting in a positive outcome of the experiment. With decreased plaque and calculus intraorally the client feels motivated to continue upholding her oral hygiene practices. Incorporating dry tooth-brushing and daily xylitol use was a success in decreasing supragingival calculus deposits. I feel confident in making recommendations in the future to incorporate both dry tooth-brushing and daily xylitol use into my client's oral hygiene care.

BUSINESS ASPECT

With expanded knowledge of dry tooth-brushing and xylitol use incorporated into daily routines, I believe there will be a decrease in oral diseases. I believe that as more

clients are informed of the benefits of xylitol we will start to see a decline in caries and gingival diseases. As a registered dental hygienist, we can take pride in knowing that we are offering quality care to our clients, helping to decrease oral disease. With potential declining rates of oral disease, the client will have a higher satisfaction rate with their oral health needs being met. The client will be more content with their dental experience and possibly require less restorative or preventative procedures. As a hygienist, this would be an acceptable and much strived for goal, as the basis for dental hygiene therapy is prevention. However, from the dentist's standpoint, being that their business is based on dental disease, I can see this becoming a financial concern, as the need for restorative procedures declines. With decreasing dental disease, revenue will inadvertently decline as well. I could see this potentially causing tension between professions.

The manufacturers of xylitol products will benefit greatly. With information more readily available to the population, with the many benefits of xylitol products, sales will increase. This will result in a financial gain for the suppliers and manufacturers.

With our generation moving towards making healthier, more informed choices regarding our health, I could see the population incorporating xylitol into their daily routine. Being that xylitol is an all natural sugar alternative, with many benefits; I believe it may become an alternative to fluoride use. Potentially decreased fluoride use could lead to a decrease in office fluoride treatments, resulting in a decrease in revenue for dental offices. If xylitol becomes more mainstream, with more awareness brought to it, I could see a decrease in fluoridated toothpaste that is readily available on the shelf. This

could lead to a decrease in sales with non-xylitol toothpaste manufacturers.

IMPLICATIONS/CONCLUSION

Knowing the impact xylitol has on the oral cavity is of great significance. Xylitol has been proven to decrease the oral bacterial count by up to 90%, resulting in a decrease in dental caries and dental plaque. The use of xylitol products, 4 to 5 times a day, further decreases bacterial plaque and calculus accumulation. Dry tooth-brushing is sufficient in decreasing dental plaque and adversely calculus deposits on the mandibular anterior lingual surfaces. Combining daily xylitol use and dry tooth-brushing results in a reduction of bacterial plaque and supragingival calculus deposits; ultimately resulting in a healthier oral environment. As a dental hygienist, this information holds extreme importance in counseling our clients on preventative measures to improve their oral health status.

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