FLUORIDE UTILIZATION IN THE 21ST CENTURY

Fluorides and their use for the prevention of dental caries has been highly researched and discussed for over 50 years. The unique effects on caries progression as well as caries initiation have been at times, controversial amongst dental professionals and lay communities. Historically, the benefits of professional fluoride utilization through in-office gel/foam delivery, systemic delivery and take home use have been associated with the prevention of dental caries. However, the action of fluoride on plaque has important preventive as well as therapeutic benefits on periodontal infections and oral health maintenance.[1]

It is imperative for all dental professionals to understand the effectiveness of fluorides as caries prevention agents and to have knowledge of the protocols for utilization of all available fluoride products. Adherence to these protocols will ensure efficient and effective utilization of appropriate fluorides.

History of Fluorides

Pioneering work by Dean and coworkers (1942) found that it was generally believed that the major caries-preventive effect of fluoride was preeruptive.[2] " Recommendations were based on the assumption that incorporation of fluoride in the enamel apatite lattice would confer the enamel a resistance to acid dissolution, i.e., that a high intake of fluoride during tooth formation and mineralization would result in fluoride-rich enamel, with enduring resistance to dental caries".[3] As research and knowledge in the field of fluoride continued, it became apparent that a high concentration of fluoride in

the hard dental tissues was of less importance than a moderate increase in fluoride concentration in oral fluids.

After accepting Dean's research for approximately 25 years, the mode of action of fluoride was thought to be its incorporation into the apatite-like crystals during development, resulting in crystals that were highly resistant to subsequent posteruptive acid attack. However compared to the posteruptive effects, the preeruptive mode of action is now considered to be very minor. Dental professionals now accept fluoride mechanics as caries-preventive and caries controlling in the posteruptive phase as the standard for fluoride delivery to their patients.[4]

Mode of Action

Fluoride utilization is the second most effective method for prevention of dental caries following removal of debris.[5] Modern concepts of fluoride mechanisms of action emphasize a daily usage therefore establishing and maintaining a significant concentration in saliva and plaque fluid and thereby maintaining a level of fluoride dissolution in the enamel surface. While the caries inhibition of fluoride has been proven to be almost totally posteruptive, the preeruptive benefits are obvious during the developmental phase of tooth eruption where the occlusal pits and fissures are protected by fluoride utilization in the posteruptive phase. Fluoride is at its highest levels nearest the surface where the tissue contacts fluid, which supplies the fluoride ion. The enamel surfaces, in the preeruptive stages, benefit from topical application

while the pulpal chamber releases fluoride, which has been stored in the mineralized tissue, from ingestion, via the dentinal layers.

When preparations with a high content of fluoride are applied to the teeth, calcium fluoride precipitates out to provide free fluoride ions. The fluoride ions act as a reservoir of fluoride during demineralization and remineralization. The fluoride ions remain in solution until the pH drops below 6.0 in dental plaque during a cariogenic challenge. The ions then released can prevent demineralization by entering partially demineralized crystals and begin to remineralize. Remineralized areas often have increased mineral content over their previous state. The presence of fluoride ions greatly enhances remineralization.[6]

Patients who suffer from Xerostomia, orthodontic patients and those who have highly cariogenic diets or patients who have less than adequate oral hygiene routines are excellent candidates for fluoride treatments as they are commonly regarded as high caries risk patients. Patients with low caries risk also benefit from topical fluoride due to the ability of fluoride to reduce acid formation in the dental plaque, reduce plaque adhesion and change the ecology of the plaque microflora thereby preventing the formation of carious lesions.[7] Caries can be prevented through mechanical removal of bacteria, however a program, which combines fluoride therapy and improved oral hygiene maintenance, is most beneficial for these particular patients.[8]

The documented statistics show that 17% of pediatric patients account for 67% of the total caries experience.[9] This data should translate into foundational principles for clinical modalities to support specific analysis of exposures to fluoride and determination

of the types of fluoride to be utilized during in-office procedures. Knowledge of the appropriate selection of Acidulated Fluoride Phosphate (APF) or Neutral Sodium Fluoride (NaF) is key in treatment of specific patient needs and aids their ability to comply with in-office treatment as well as adjunctive prescription (take home) fluorides.

Topical Fluoride Utilization

Acidulated Phosphate Fluoride was first introduced in the early 1960's. These agents contained 1.23% fluoride in the form of sodium fluoride at pH 3.0. Phosphate was added to an acid solution to depress calcium fluoride formation and increase fluorapatite formation.[10] APF has been used for caries inhibition as research has demonstrated remineralization of enamel. The majority of fluoride uptake into enamel using a 1.23% APF gel has been proven to occur during the first minute of application. During the following three minutes of application additional uptake occurs, however there appear to be several advantages to using the one-minute application procedure for APF instead of the four-minute.

Several of advantages are:

- Lessens the potential for fluoride ingestion
- Decreases the adverse effects of etching of esthetic restorations
- Increases patient tolerance
- Improves patient compliance

A patient who is classified as an active caries risk would require fluoride applications of APF 1.23% twice yearly, whereas, the patient with rampant caries should receive

topical fluoride treatments on a quarterly basis and may also require a home fluoride treatment program to control caries formation.[11]

~Sodium Fluoride Gel 2% gel

Neutral Sodium Fluoride (NaF) was first introduced in the early 1940's as a 0.1% aquaeous solution applied at four-month internals for two years.[12] Currently NaF is applied in a 2% gel and is recommended for patients with root caries, Xerostomia, orthodontic appliances and esthetic restorations (laminate veneers, porcelain or composite restorations). While very effective, Sodium Fluoride is recommended for the four-minute delivery only. It has been clinically proven to reduce caries and is most beneficial to patients when delivered at three month intervals accompanied by prescription fluoride for take home usage. [12,13,14]

Clinical Application

While topical agents are safe and considered harmless, they must be used as directed by the manufacturer. [15,16] When administering fluoride through a tray method for children less than 16 years of age certain procedures should be adhered to minimize ingestion of the gel/foam. A variety of recommendations are:

- Limit the amount of gel/foam to no more than 2ml or 40% of the tray capacity
- Limit gel to 5 to 10 drops in the tray
- Use a timer
- Seat the patient in upright position with head tilted forward

- Use suction throughout the fluoride treatment
- Continue to use suction for 30 seconds after application and/or expectorate saliva for approximately one minute
- Never leave a child unattended while administering a fluoride treatment
- Keep fluoride solutions out of reach of a pediatric patient[17]

Delivery of in-office of fluoride is best when administered with a tray specifically designed for this purpose. On rare occasion, cotton rolls and swabs may be used instead of a fluoride delivery tray.

Fluoride delivery using a tray method:

- Select tray of appropriate size
    - Entire dentition must be covered including areas of recession while allowing for gel to come in contact with the tooth structure
    - Ends of tray (distal portion) should be closed to ensure gel does not flow over into patients mouth
    - Foam lined trays are ideal as they conform to patients dentition and allow for flow of gel to all surfaces
- Place gel in tray as described above
- Insert tray into patients mouth
- Insert saliva ejector between trays, being sure that patient is comfortable (cotton rolls may need to be used on opposite quadrants to balance occlusion with this method)

- Remove tray from patients mouth
- Advise patient to expectorate immediately following tray removal
- Utilize high volume suction if necessary to remove excess fluoride following treatment
- Advise patient to not eat or drink for 30 minutes following procedure

Use of Home Fluoride

Use of prescription home fluorides benefits patients with individualized needs such as decalcification, which often accompanies orthodontic treatment; dentinal hypersensitivity, root caries, post periodontal surgery, recurrent decay, Xerostomia and/or post head and neck radiation therapy. Two types of home fluorides Stannous 0.4% and sodium 1.1% fluoride gels or pastes are recommended.

Stannous Fluoride 0.4% gel is recommended for patients with dentinal hypersensitivity as it occludes the dentinal tubules, inhibits plaque accumulation and protects areas at risk for decalcification. When prescribing stannous fluorides, the professional must take into consideration prior dental restorative treatment as the product may cause extrinsic stains on esthetic restorations as well as natural dentition.

Stannous fluoride use is most beneficial to patients when used at least once per day and allowed to remain on dentinal surfaces for one minute while brushing. Following toothbrushing remind patient to swish fluoride for one minute and then expectorate. This recommendation will be of most benefit to your patients as it allows the fluoride ion to penetrate the tooth structure.

Sodium Fluoride 1.1% take home gel is routinely prescribed for patients with esthetic restorations who need more protection for caries reduction especially those patients with a history of cervical caries and patients suffering from Xerostomia or post head and neck radiation therapy who cannot tolerate and acidic environment. Sodium fluoride pastes / gels which are sweetened with Xylitol provide an additional benefit to the patients in light of recent research on Xylitol and it's benefits of plaque inhibition. Sodium Fluoride is ideal patients suffering from sensitivity due to the use of whitening agents. Fluorides with a lower concentration provide a reduction in the dose of fluoride, which replenishes fluoride in the tooth structure, saliva and plaque and supports the remineralization process for all individuals regardless for their caries risk assessment. [19]

Recommended to be used following a regular brushing or as a daily dentifrice however optimal results occur when patients expectorate and do not rinse for a minimum of 30 minutes following usage.

Conclusion

Fluoride therapy is considered an important modality for the prevention of decay and to aid in the remineralization of incipient lesions, to reduce dentinal hypersensitivity and reduce plaque accumulation. While fluorides offer additional benefits to dental patients, numerous areas such as oral hygiene instruction, nutritional counseling, comprehensive restorative and diagnostic treatment plans combined with customized fluoride modalities may provide optimal care.[20]

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