Is Fluoride F*******?

STUDY CLUB 11/4/22

Problems with fluoride

Some people are afraid of it

Fluoride toxicity is possible

So how much fluoride is too much?

- Tooth fluorosis is common in areas where water fluoride levels are greater then 1.5mg/liter
- Bone fluorosis in adults takes about 5mg/day for 20 years
- Lethal dose of fluoride in an adult is 2000mg fluoride
- Lethal dose of fluoride in a child is 5mg/kg
  - These are conservative estimates, it may take more fluoride to actually cause death.

Other potential harms of too much fluoride:

- Some potential evidence suggests that too much fluoride can act as a neurotoxin in developing brains, a systematic review conducted by the US Department of Health and Human services concluded that fluoride levels above 1.5mg/L lead to decreased IQ in children. Levels lower then 1.5 mg/l had unclear effect on development and IQ of children.
- Other authors have suggested those studies do not rule out many other factors that could also result in lower IQ's.
- Either way – these studies have to do with fluoridated water not tooth paste. – But they do induce fear in parents.

How much fluoride is in tooth paste?

- Average large tube of tooth paste 130-160 g
  - Average toothpaste is 1000-1500ppm
  - So about 143-176 mg fluoride in a large tube of tooth paste.
  - Sample tooth paste is 24 g = 26 mg fluoride

It's essentially small children that are greatest risk (small risk)

- For an adult to get a lethal dose of fluoride they would need to eat 10 large tubes of tooth paste. = Not likely going to happen.
- For an infant a sample sized toothpaste could kill them
- For a small child eating a whole regular sized tube of tooth paste could kill them.
- A recent update by centers of disease control and prevention in the US showed that preschoolers and toddlers were still being exposed to greater then recommended amounts of fluoridated toothpaste early in life (1)
- In practice there are very few deaths from fluoride overdose in our country. The only thing I could find was that there was none in 2019. But I will assume some years there are deaths

Conclusions about fluoride

- 1) Fluoride definitely strengthens teeth, promotes remineralization, is an antibacterial and reduces caries rate
- 2) Topical application of fluoride has little risk
- 3) For adults even excessive use of fluoride tooth paste has little risk of adverse effects
- 4) Greater risk for fluoride toxicity with small children

Bottom line

Small children or infants especially ones that live in areas with fluoridated water have a small risk for negative outcomes with using a fluoridated tooth paste.

i.e. – Children who have access to and could eat a bottle of toothpaste are at risk

i.e. If water is highly fluoridated (above 1ppm) and a child is using daily large amounts of fluoride tooth paste and swallowing it, then risks of fluorosis and plausible hindered neurodevelopment could be increased.

AN OPTION FOR THOSE OPPOSED TO FLUORIDE:

- TOOTH PASTES CONTAINING HYDROXYAPATATE (HA) OR NANO-HYDROXYAPATATE (NHA)
  - ONLY DIFFERENCE BETWEEN HA AND NHA IS PARTICLE SIZE OF THE HA.
    - NANO REFERS TO PARTICLE SIZES OF 1-100nM

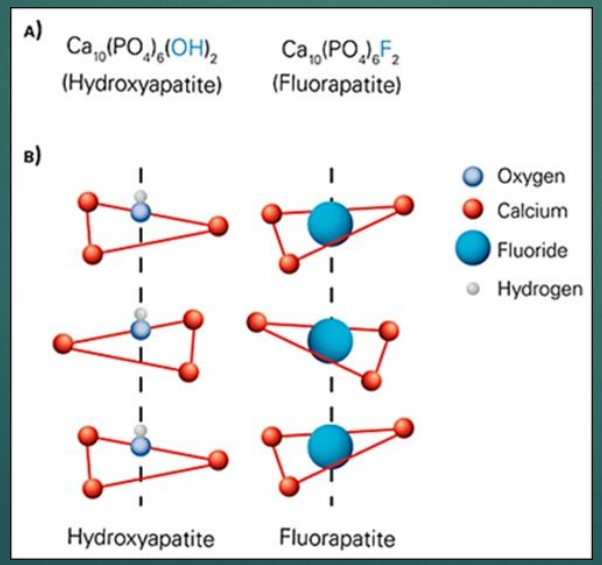
What is Hydroxyapatite (HA)

- Is the primary calcium phosphate mineral in human mineralized tissues (teeth and bones)
- Nano HA – just means really small particles. (About 20-80 nM in length)
- HA in tooth pastes has been used for years in other countries - in 1980's Japan approved 1st HA containing toothpaste for sale to treat dentin hypersensitivity and caries prevention(1)

- HA been used for boney regeneration for years and is much larger (sand granule size)

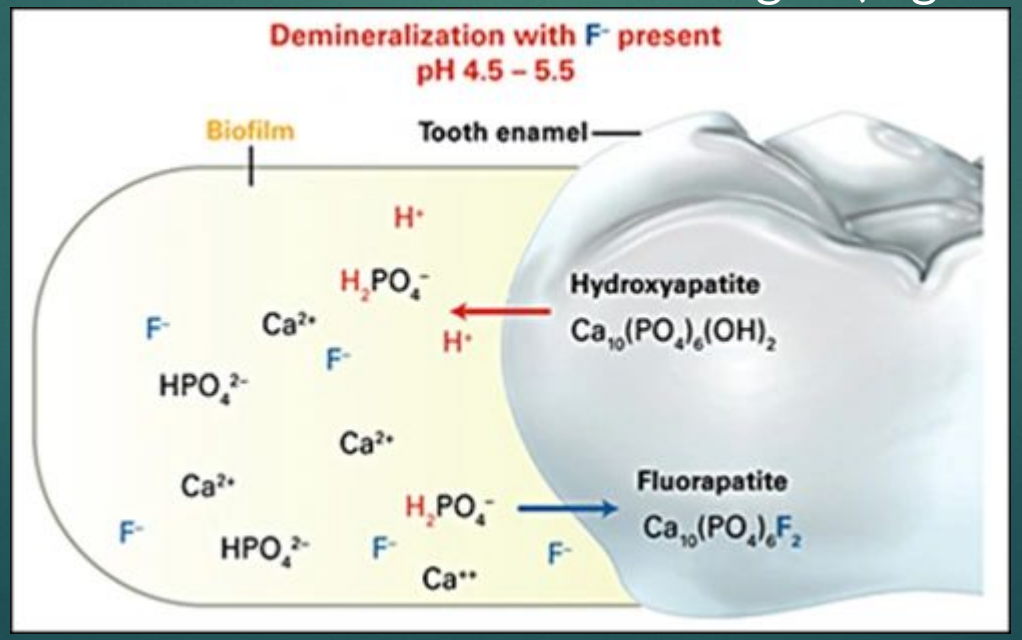
Review: How fluoride works (from – dentalcare.com) - crest

When fluoride is present in oral fluids (i.e., saliva), fluorapatite, rather than hydroxyapatite, forms during the remineralization process. Fluoride ions (F^-) replace hydroxyl groups (OH–) in the formation of the apatite crystal lattice (Figure 3). In fact, the presence of fluoride increases the rate of remineralization.



Fluoride cont

- Fluorapatite is inherently less soluble than hydroxyapatite, even under acidic conditions. When hydroxyapatite dissolves under cariogenic (acidic) conditions, if fluoride is present, then fluorapatite will form. Because fluorapatite is less soluble than hydroxyapatite, it is also more resistant to subsequent demineralization when acid challenged (Figure 4).



Fluoride cont:

- Fluoride absorbed by bacterial cells interferes with their metabolism and leads to bacterial cell death (fluoride is antibacterial)
- Fluoride ions when present in saliva and plaque shift the – demin/remin cycle toward remineralization

How NHA works

- NHA particles penetrate enamel defects and adhere to existing enamel structure (some authors suggest NHA can penetrate defects deeper then fluoride)
- NHA provide calcium and phosphorus ions for remineralization
- NHA adhere to plaque and provide ions for remineralization after an acid attack
- NHA particles reduce the adherence of bacterial plaque to the tooth. “the NHA particles have been shown to bind to biofilm bacteria, inhibit their activity, and act as an abrasive to prevent biofilm accumulation” (1)

How fluoride and NHA work the same

- They both promote remineralization.
- They both are dissolved in saliva
- They both effect biofilm
- They both reduce risk of caries progression.

How fluoride and NHA work differently

- Remineralization after fluoride results in Fluorapatite, NHA just makes more HA
- NHA particles are directly incorporated into enamel structure and ions are freed up for remineralization. Fluoride only works via ions/remineralization.
- Fluoride works as an antibacterial, NHA inhibits but does not kill bacteria
- Fluorapatite is less soluble in acidic conditions, but NHA may be able to penetrate deeper into the demineralized defect
- Fluoride is bactericidal but may also kill good bacteria

Advantages of HA toothpaste

- It does reduce risk for caries similar to fluoride tooth paste.
- Much better then no toothpaste or tooth paste without fluoride or HA.
- Will reduce caries rate for anti-fluoride people
- Less risk for toxicity with infants or small children who eat the whole tube of toothpaste
- Less risk for fluorosis in infants and small children living in areas with fluoridated water

Disadvantages of HA toothpaste

- Hard to find
  - Current HA/NHA toothpastes on the market do not always disclose what percentage of NHA/HA they are using – they may be using less then what the studies have shown to be effective (10-15%)
- More Expensive
- Not FDA approved
- Not ADA approved
- Has been studied/tested less then fluoride

- Even in countries where it has been approved - it is approved for children 2 and over. It seems the greatest advantage of the toothpaste is for children 2 and under. 🙁

Is NHA safe?

- We think so. No current evidence that NHA/HA is toxic. Theoretically in large doses calcium and phosphate absorbed by cells could lead to cell death, (absorption by cell, sedimentation in cell wall and then cell death). However as calcium phosphate is dissolved nearly instantly when it comes in contact with stomach acid, ie when swallowed, making absorption by cells in high enough quantities to be toxic unlikely. Inhalation of calcium phosphate would be higher risk, but this is not a concern with adding HA to toothpaste. (3)
- HA is already in many products used in dentistry and has so far tested to be safe – Granular form HA used for socket preservation and to fill periodontal defects, - studies on biocompatibility show when this is completed no evidence of toxicity or inflammation. Also used as a coating on dental implants and has been shown to increase osteointegration and as an ingredient in restorative products such as cement. (2)
- Only current disadvantage is that it has not been studied as well/as much as fluoride.

What do the studies say about HA?

Study	Subjects	Product	Controls	Study type	conclusions
Paszzynska et al. 2021	177 children ages 3-7	Kinder Karex (10% HA)	500 ppm fluoride	RCT – 1 year	Both fluoride and HA slowed caries progression similarly
Grocholewics et al 2020	92 adults ages 20-30	HA Gel 10% (ApaCare Repair)	Ozone and HA + ozone	RCT 2 years	HA gel provided significant remineralization effects
Badiee et al. 2020	50 subjects ages 10-35 years old	6.7 % HA toothpaste	fluoride tooth paste	RCT 6 months	HA and fluoride reduced white spot lesions post ortho
Schlagenhaug et al. 2019	150 subjects age 12-25	Karex -10% HA	1400ppm fluoride	RCT 6 months	HA works as well as regular strength fluoride in preventing progression of caries.
Amaechi et al 2020	Bovine teeth – simulated demin with acid	Karex (15% HA)	1250 ppm fluoride gel	RCT 1 month with weekly Gel application	HA was effective as F Gel in remineralization early caries

What else do studies say about HA?

- 15% NHA toothpaste is effective at reducing dentin hypersensitivity after 2-4 weeks of application.
  - Vano Et al. 2014 – RCT 105 subjects – test vs placebo and F toothpaste

Is fluoride finished?

- No, fluoride is effective and has little risk in topical applications.
- Fluoride is widely available and cheap.
- For adults NHA has little advantages over fluoride toothpaste
- Tooth paste manufactures have invested heavily in fluoride and it will be expensive for them to do the same for NHA. Which means it will take a long time for there to be a change.

Does NHA toothpaste have a place?

- Yes! Great option for patients that are opposed to fluoride. It will definitely protect their teeth better then other "natural" alternatives.
- Great option for parents who are concerned about their infants eating their siblings tooth paste.
- Great option for people living in areas where water is heavily fluoridated (greater then 1.5 ppm)

Where can I get HA toothpaste? MOSTLY ONLINE

- Kinder Karex (USA)– 10% HA - $22 for a 3 pack
- Biorepair kids (Italy)– 15%??? (1) study said this but % not given in ingredients $8/tube
- Apagard tooth paste (japan) - % not found - $26/2 tubes
- David's toothpaste with NHA(USA) % not disclosed - $12/tube
- Risewell HA toothpaste (USA) % not disclosed - $10/tube

References

- 1) Limeback, H. – et al. Biomimetic hydroxyapatite and caries prevention: A systematic review and meta-analysis. Canadian journal of dental hygiene 2021;55(3):148-159.
- 2) Pepla E, Besharat LK, Palaia G, Tenore G, Migliau G. Nano-hydroxyapatite and its applications in preventive, restorative and regenerative dentistry: a review of literature. Ann Stomatol (Roma). 2014 Nov 20;5(3):108-14. PMID: 25506416; PMCID: PMC4252862.
- 3) Epple M. Reviw of potential health risks ssaociated with nanoscopic calcium phosphate. Acta Biomater. 2018;77:1-14