



Phase 1:

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JUNIOR STUDIO II | SPRING 2019

# Medical Design Project Children's Dental Aid Caryn Tabalanza

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# 1.1 design exploration

Most parents educate their children about good oral hygiene techniques from a young age, however many children tend to practice techniques either poorly, or not at all, resulting in cavities, loss of teeth, and/or long-term effects in regards to the mouth. The recommended age for children to begin brushing their teeth independently is around age 6-8, however most parents allow independence by as early as their full set of 20 primary teeth come in (usually at three years old). This often results in poor dental monitoring as well as hygiene practice. Around 20% of children (5-11 years old) have 1 untreated decayed tooth, and tooth decay occurs more frequently in lower income families (25%) than in higher income families (11%). Although it's rare that dental problems result in more than a decayed tooth, continued poor practice of hygiene can lead to more problems in the future.

Immediate problems of poor oral care could result in the loss of teeth. A common misconception among children is that the first set of primary teeth are disposable and require little to no care, however they act as placeholders for when permanent teeth grow in. The premature loss of teeth could affect how the permanent teeth grow in; it could result in crooked, misaligned, or wrongly positioned teeth. Aside from general dental health, the poor maintenance of dental hygiene can affect a child's day-to-day life as well as their adulthood. Dental caries can largely affect a child's self esteem in areas such as appearance and speech. Seeking professional care for teeth is also expensive, and days taken off of school for treatment can affect a child's education.



## 1.2 history of the situation

Dentistry has a long history, however it wasn't until 5000 B.C. that there were written descriptions of dental concerns. The first text found suggested that dental decay was a result of "tooth worms," a concept that wasn't proven false until around 1700 B.C. when the Ebers Papyrus text describes numerous teeth diseases and their cures. Remedies were further explored in around 500-300 B.C. in Hippocrates' and Aristotle's writings concerning treatments and extractions. Floss wasn't credited for invention until around 1815 when a New Orleans dentist suggested patients to clean around and in between the teeth with a silk thread. Johnson & Johnson later established a patent in 1898 for dental floss made from the same material as medical silk stitches. In the 19th century, the world's first dental school, the Baltimore College of Dental Surgery, was established

by Horace Hayden and Chapin Harris. The American Society of Dental Surgeons was also established in 1840 (but dissolves in 1856) and the American Dental Association was later formed in 1859. In the 1880s the modern tubed toothpaste was developed and mass produced, replacing dentrifice. It also wasn't until 1938 that the nylon toothbrush was developed, which replaced toothbrushes previously made with boar bristles attached to the handles. 30 years later the electric toothbrush was developed in Switzerland, and its cordless counterpart was made a year later in 1961. Just as the nylon toothbrush was created, nylon floss replaced silk in the 1940s and a waxed version was developed soon after.

# 1.3 existing patents

A

Name: Dental Flosser  
Inventors: Song Jun Ding, Steven A. Slabine  
Publication Number: US 2004/0134512 A1  
Date of Publication: Jul. 15, 2004

Dental flosser in which the flosser is adjustable to different angles to assist with reaching back teeth. The floss holder and handle are attached by a hinge and is locked into place when in use and when not in use.

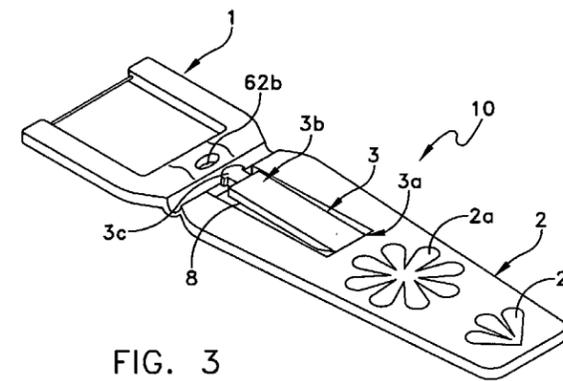


FIG. 3

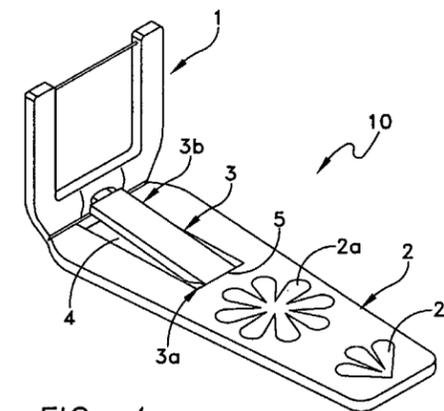


FIG. 4

A

B

Name: Dental cleansing device and interdental floss for such a device  
Inventors: Frederic Barth  
Patent Number: 5,183,064  
Date of Publication: Feb. 2, 1993

Dental flosser with dispensable floss. The floss is strung through the two arms and then mounted to a stopper to keep the floss taut when in use.

U.S. Patent Feb. 2, 1993 Sheet 2 of 6 5,183,064

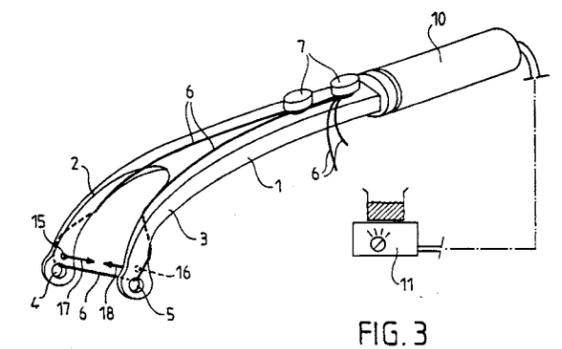


FIG. 3

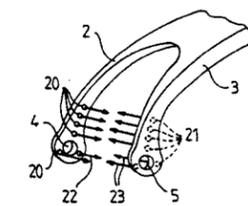


FIG. 4

B

# 1.3 existing patents

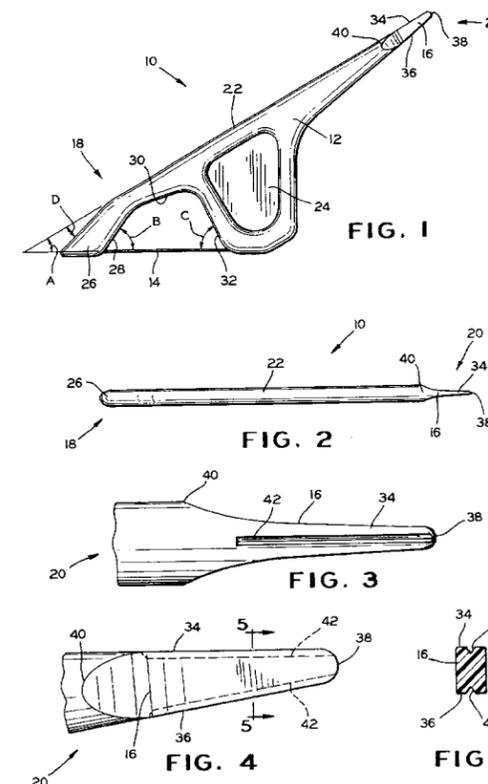


C

Name: Disposable flossing and debrider device  
Inventors: Richard T. Krynicki  
Patent Number: 5,704,379  
Date of Publication: Jan. 6, 1998

A disposable dental flosser with an angled molded frame and a pre-strung and tensioned strand of dental floss.

U.S. Patent Jan. 6, 1998 5,704,379



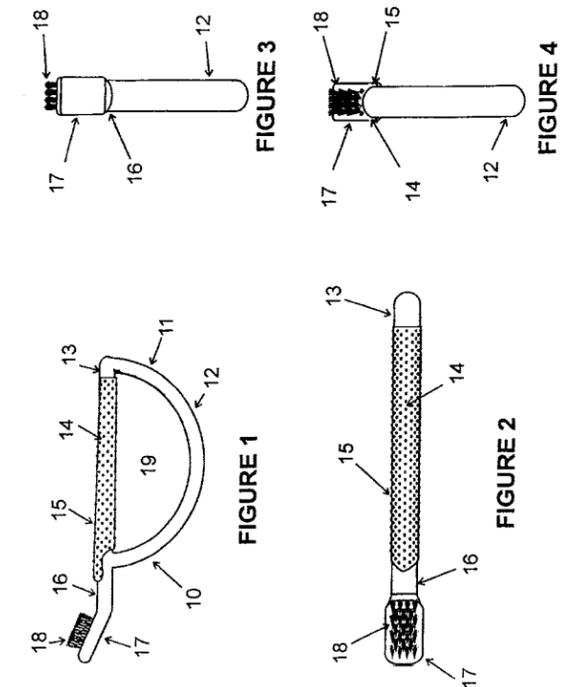
C

D

Name: Toddler/child toothbrush  
Inventors: Roxanne Thompson  
Patent Number: 5,623,739  
Date of Publication: Apr. 29, 1997

A toothbrush designed for children. Consists of a handle shaped in a semi-circular ring in which the shape limits insertion into the mouth and prevents mouth injury.

U.S. Patent Apr. 29, 1997 5,623,739



D

# 1.4 related literature



[http://www.aapd.org/assets/1/7/Qualis\\_White-Paper-Oral-Health-Primary-Care\\_2016.pdf](http://www.aapd.org/assets/1/7/Qualis_White-Paper-Oral-Health-Primary-Care_2016.pdf)

By: Jeffrey Hummel, Kathryn E. Phillips, Bre Holt, Catherine Hayes

A collaborative effort by a team of about 24 experts in the field, this packet explains dental statistics from multiple age groups, ranging from adolescents to seniors. The packet explains that **25% of children aged 2-5, and 50% of children aged 12-15 suffer from dental caries**. Another useful section of the packet explains how dental decay can impact a person's **everyday life**, such as **self-esteem about appearance or speech problems** resulting from oral health issues.

<http://www.dentalproductsreport.com/dental/article/how-actually-get-kids-brush-their-teeth>

By: Renee Knight

This article focuses on the parental aspect of how children take care of their teeth. It explains that good **dental healthcare begins with the parents** and that they should actively monitor their children's teeth. The article suggests that good oral hygiene correlates to doing well in school as well as general social acceptance.

The second half of the article suggests ways to make brushing more fun for children. Several ways include allowing kids to choose their own toothbrush or toothpaste. Other methods include **positive reinforcement and general education** about the effects of not maintaining oral hygiene.

<https://www.mouthhealthy.org/en/az-topics/b/baby-teeth>

By: American Dental Association

This article explains the growth and general benefits of baby/primary teeth. It explains that the first 20 teeth a child gets act as **placeholders in the jaws** for permanent teeth. Maintaining good oral hygiene before and after baby teeth come in can ensure that permanent teeth won't grow in **crooked, crowded, or misaligned**. While crooked teeth can be a result of jaw structure, the premature loss of baby teeth can further instigate the problem. Parents should be wiping their baby's mouth and gums with a moist washcloth even before their first set of teeth come in, and afterwards should **supervise their child's toothbrushing**.





# 1.5 product comparison

									
General	Product Name:	Dental Floss Picks	Sonic Electric Toothbrush	Gummy Floss	Waterpik Water Flosser for Kids	AirFloss Pro/Ultra - Interdental cleaner	Listerine Ultraclean Access Flosser	Flossaid Dental Floss Holder - 3 pack	GumChucks
	Company:	Plackers	Philips	Flexi Floss Ltd.	Waterpik	Philips	Listerine	Flossaid Corp	Oralwise, Inc.
	Location:	Grand Rapids, MI	Andover, MA	Haifa, Israel	Fort Collins, CO	Andover, MA	Skillman, NJ	Santal Clara, USA	Mountlake Terrace, WA
	Model Number:	303873518	HX6321/02	N/A	WP260	HX8332/11RW	8684	f13	170612
	Website:	<a href="https://www.plackers.com/">https://www.plackers.com/</a>	<a href="https://www.usa.philips.com/">https://www.usa.philips.com/</a>	<a href="http://www.gummyfloss.com/">http://www.gummyfloss.com/</a>	<a href="https://www.waterpik.com">https://www.waterpik.com</a>		<a href="https://www.listerine.com/">https://www.listerine.com/</a>	<a href="https://www.flossaid.com/">https://www.flossaid.com/</a>	<a href="https://gumchucks.com/">https://gumchucks.com/</a>
Human Functions: Eco / Socio	Price:	\$16	\$49.99	\$23.00	\$59.99	\$89.99	\$5.36		\$4.99
	Purchase Method:	Online, In-store	Online, In-store	N/A	Online	Online	Online, in-store	Online retailers	Online, Amazon
	Form:	Floss pick	Electric toothbrush	Silicone dental floss (Pack of 8)	Water flosser	Air flosser	Floss pick	Floss holder	Floss handles
Human Functions: Aesthetic / Cultural	Color:	Orange, Green, Blue	Aqua	Blue, Red	Green	Silver, Pink, Black	White and green	Orange, Blue, Navy, White, Green, Red	
	Texture/ Material:	Super Tuffloss,	Plastic	Medical grade rubber silicone	Plastic	Plastic	Plastic	Plastic	Latex free, BPA free plastic/nylon
	Features:	Dual grip, flavored floss, fluoride, angled head	Free interactive smartphone app with bluetooth, KidTimer and Quadpacer, 2 power modes	Thumb grips	2 tips included (classic & orthodontic), 3 pressure settings,	Single/double/triple bursts, multi-voltage charger,	Ergonomic handle, non-slip grip,	Floss tension adjuster	Handles with replaceable flosser
	Advantages:	Floss isn't wasted, easy to hold, ergonomically kid-friendly	Rechargeable, kid friendly	Re-usable, re-washable, safe for kids 6+, packed using recycled and/or degradable materials, comes in different flavors	No waste, kid friendly	No waste, rechargeable	Long handle makes it easy to reach back of mouth, floss handle is reusable (but flossers are disposed of), for ages 6+ (with adult supervision)	Floss holder can be reused multiple times, floss tension can be adjusted, can be used with any type of floss	Constant tension on floss, user doesn't have to put hands in mouth, kid friendly
Human Functions: Practical / Physical	Disadvantages:	Single use	Expensive, not recommended for young children to use independently (should have parental guidance)		Expensive, corded	Expensive	Single use	Floss has to be strung manually, not ergonomically friendly	
	Weight:	2.88 oz	12 oz	0.2 kg	1.7 lbs	1.44 oz	0.32 oz	1.4 oz (shipping weight)	0.035 lbs
	Dimensions:	0.6 x 4.3 x 7.3 in	2.5 x 4.4 x 9.6 in		5.8 x 5.2 x 9 in	5.4 x 3.3 x 9.2 in	4 x 4 x 6 in	8 x 2 x 0.5	3.25 x 0.5 x 6.5 in
Production and Function	Product method:								
	Production location:	Schonau, Germany							
	Longevity:	Single-use	Rechargeable lithium ion battery; 2 week operating time.	N/A	Warranty 24 months	Rechargeable (24 hours full charge); Battery life 1-4 weeks; Warranty 24 months	Comes with 8 single-use refill heads (replace daily)		

# 1.6 interaction matrix

	plastic handle (side A)	plastic handle (side B)	nylon bristles	paint	graphics	grip	toothpaste	sun	water	hand	eye	teeth
plastic handle (side A)		x	x*	x	x	x		x**	x**	x		
plastic handle (side B)	x			x		x		x**	x**	x		
nylon bristles	x*						x		x**			x
paint	x	x			x				x	x	x	
graphics	x			x					x	x	x	
grip	x	x										
toothpaste		x										x
sun	x**	x**										
water	x**	x**	x***	x	x							
hand	x	x		x	x							
eye				x	x							
teeth			x				x					

	floss	handle	paint	graphics	water	hand	eye	teeth
floss		x			x	o*		x
handle	x		x	x		x		
paint		x		x			x	
graphics		x	x				x	
water	x							
hand	o*	x						
eye			x	x				
teeth	x							

\* Floss should be maneuvered with handle, not hand

\* Bristles should only cover the head of the handle

\*\* Melting point of plastic is 120°C - Water/Sun temperatures should not melt product

\*\*\* Melting point of nylon bristles is 212°C



# 1.7 sequence of use



help from parent



The child shown in the sequence is shown flossing, but not necessarily well. Her **grip** on the flosser is awkward and uncomfortable and she's not necessarily getting **in between her teeth** like she should. She also has trouble **reaching** her back top and bottom teeth.

# 1.8 questionnaire to user

**As a parent, how often do you brush your teeth?**

- Twice a day (or more) (83.1%)
- Once a day (16.9%)
- A few times a week
- Rarely
- I don't brush my teeth

**Did you educate your child on why it's important to maintain proper oral hygiene when teaching them to brush their teeth? (Cavities, diseases, long term effects, etc.)**

- Yes (100%)
- No

**What did you do to encourage your child(ren) to brush their teeth? (Incentives, praise, etc.)**

(Short answer)

- None 16.67%
- General incentives/positive reinforcement 35%
- Reduced privileges/negative reinforcement 21.67%
- Education 8.33%
- Assistance/Reminders 18.33%

**How did you deal with a child that didn't want to brush their teeth?**

- Scare them into it 22.0%
- Reminders 12.2%
- Positive reinforcement 17.07%
- Negative reinforcement 0.10%
- Monitoring/assistance 19.61%
- Education 0.10%

**Which of the following did you encourage your child to do in their routine? (Multiple Choice)**

- Toothbrush 100%
- Floss 50.8%
- Mouthwash 37.3%

# 1.9 summary of findings

- Parents that do brush their teeth tend to educate their children as well.

- Only 8.33% of parents educated their children on proper dental care to encourage them to brush their teeth.

- Only half of parents encouraged flossing in their child's daily routine.

- The most common way for a parent to motivate a child to practice oral hygiene was to scare them into it either through pictures or through intensive surgical care.

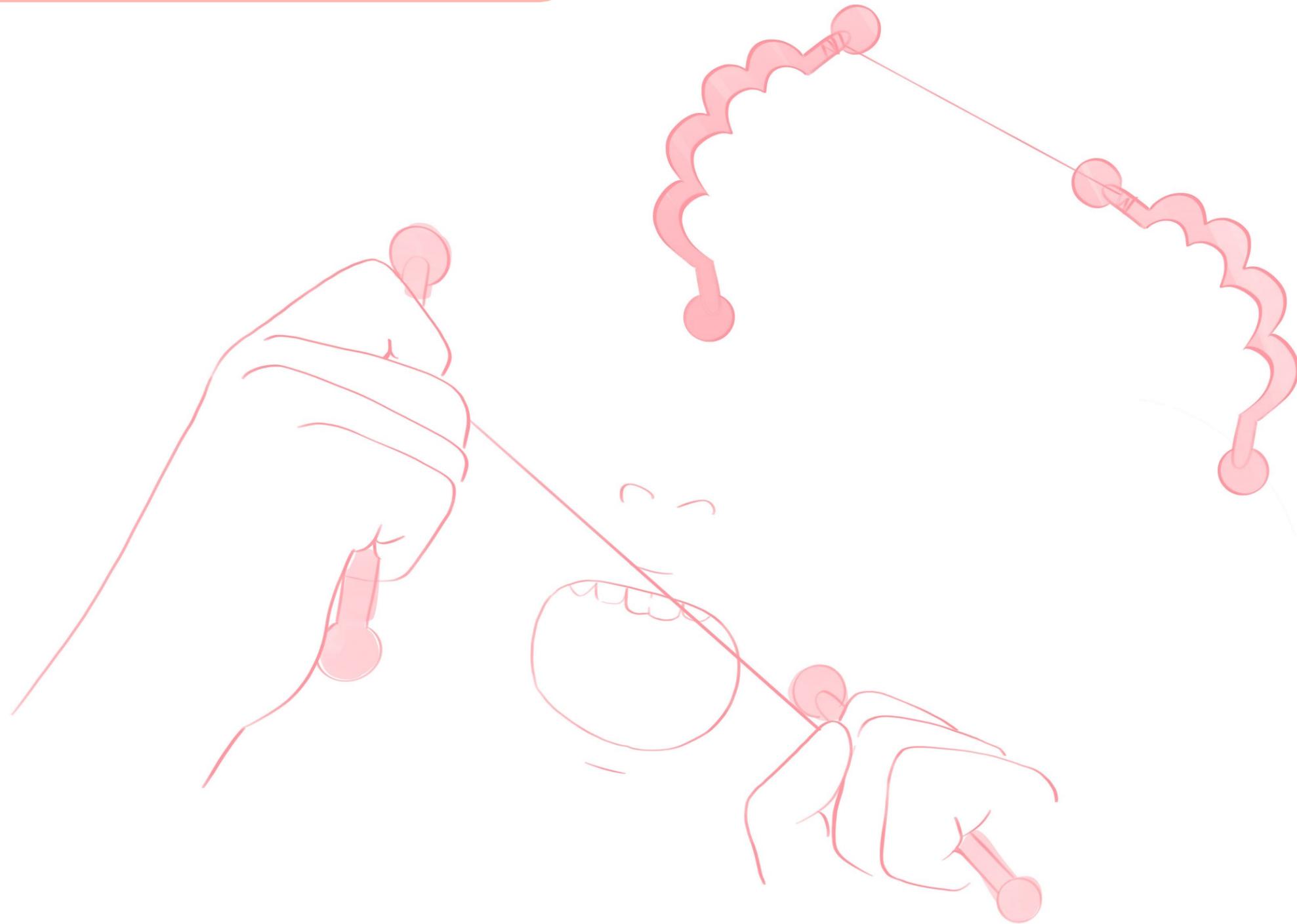
Although this method works, it doesn't necessarily mean that children understand the importance of dental care. The fear of losing their teeth is temporary until they get scared into it again.

-Because of this, I want to design a product that will educate children in maintaining a permanent routine for oral hygiene rather than a chore that they only do when instructed.

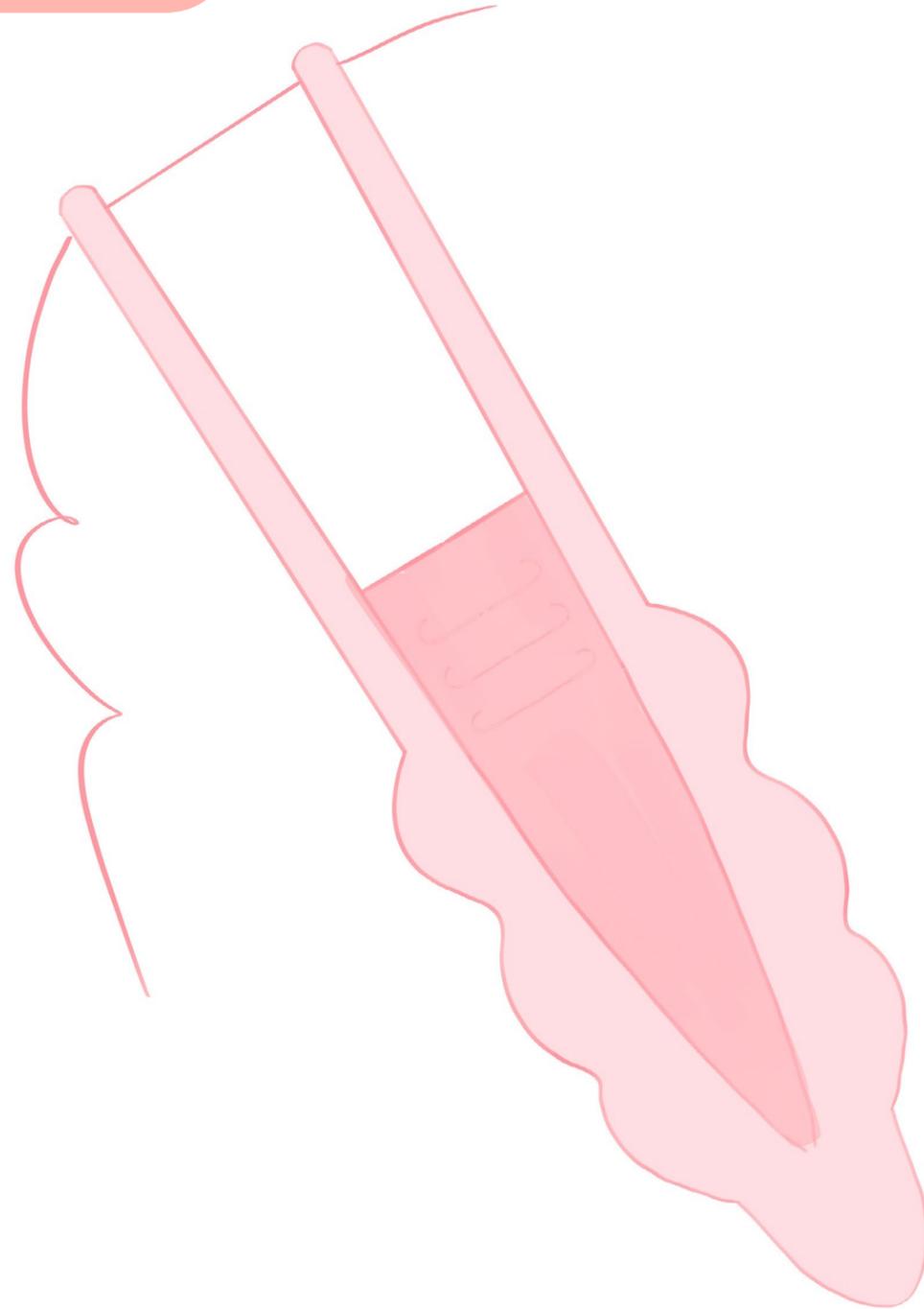
# 1.10 image board



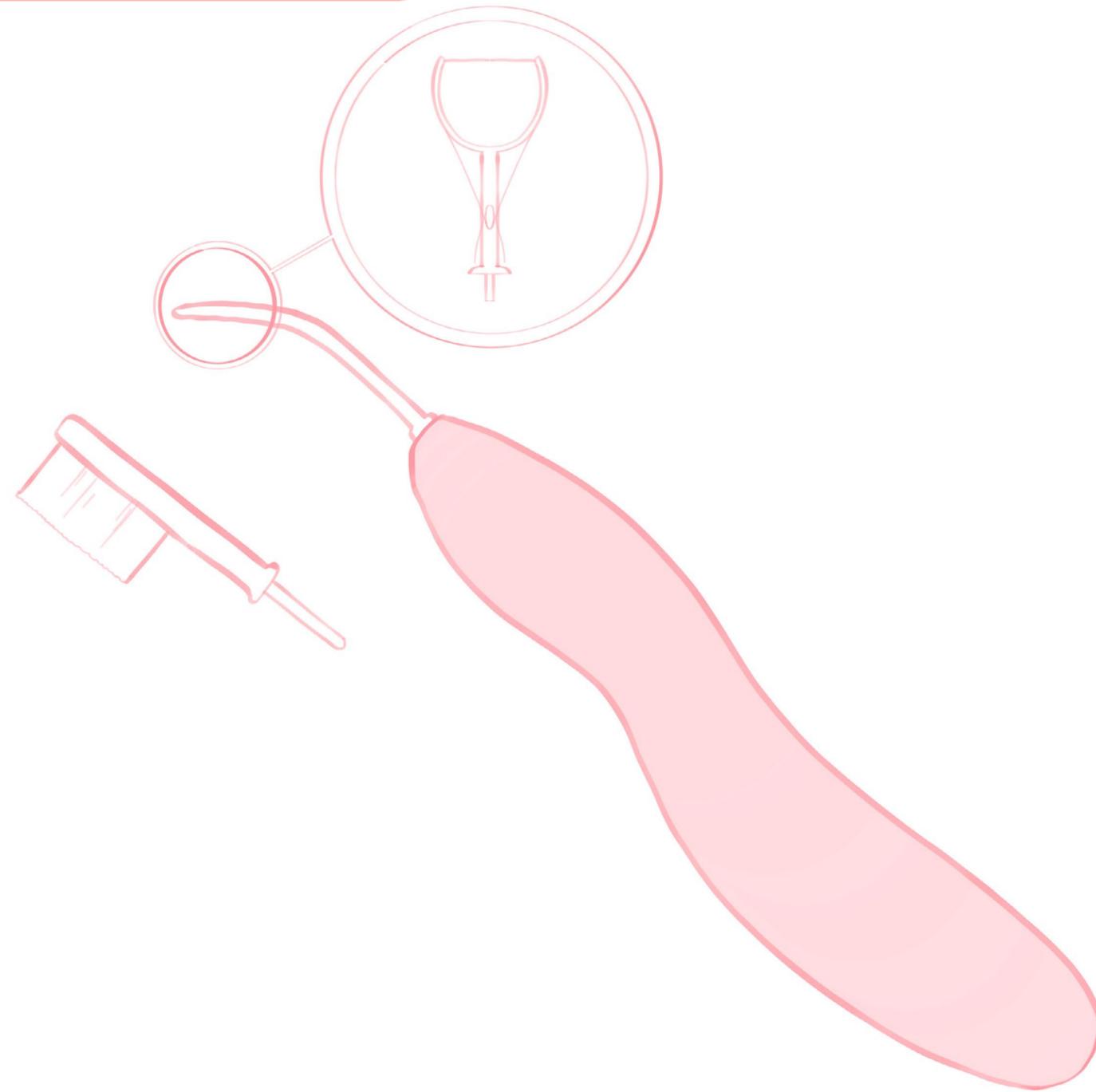
# 1.11 sketches



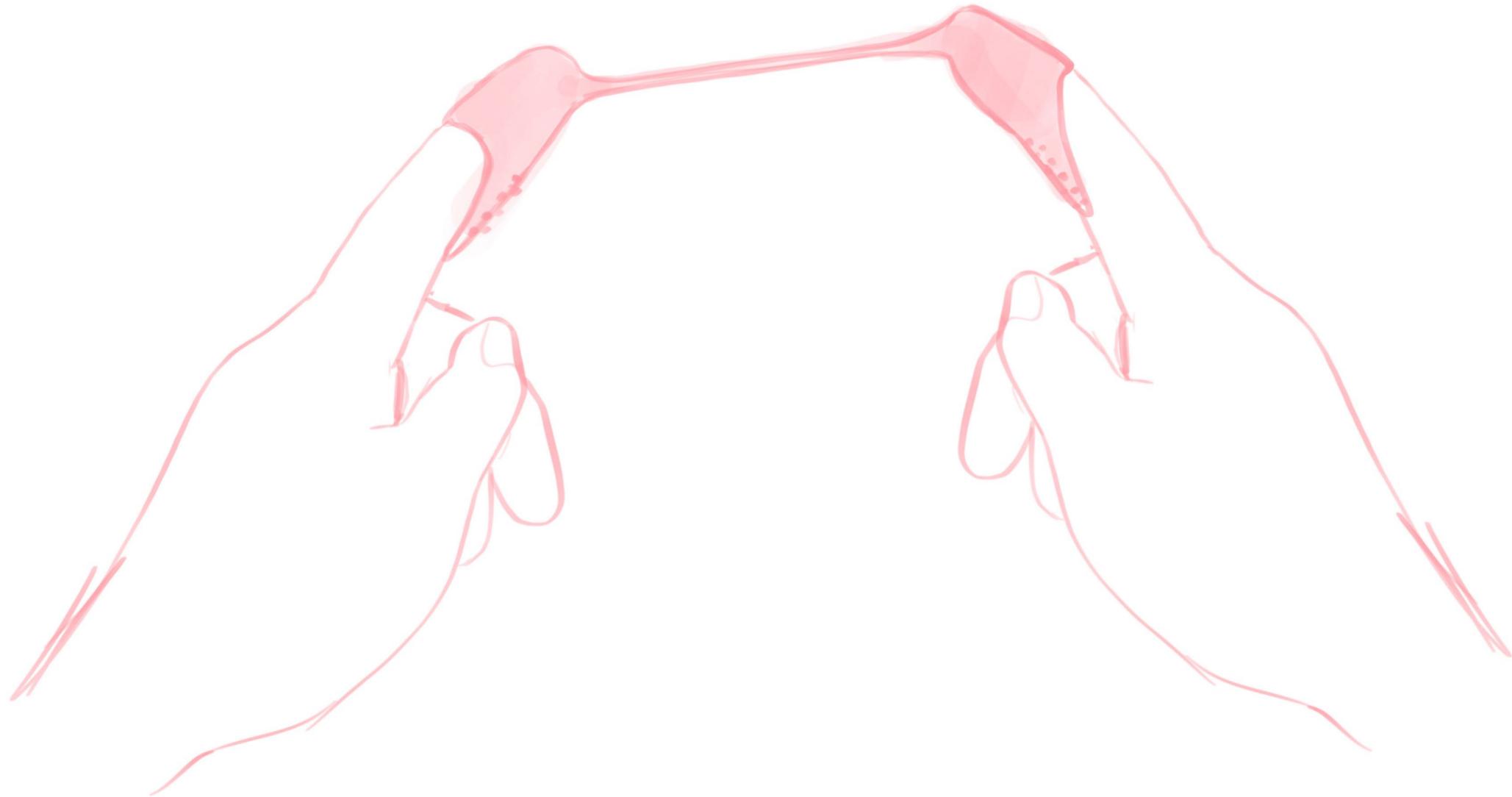
# 1.11 sketches



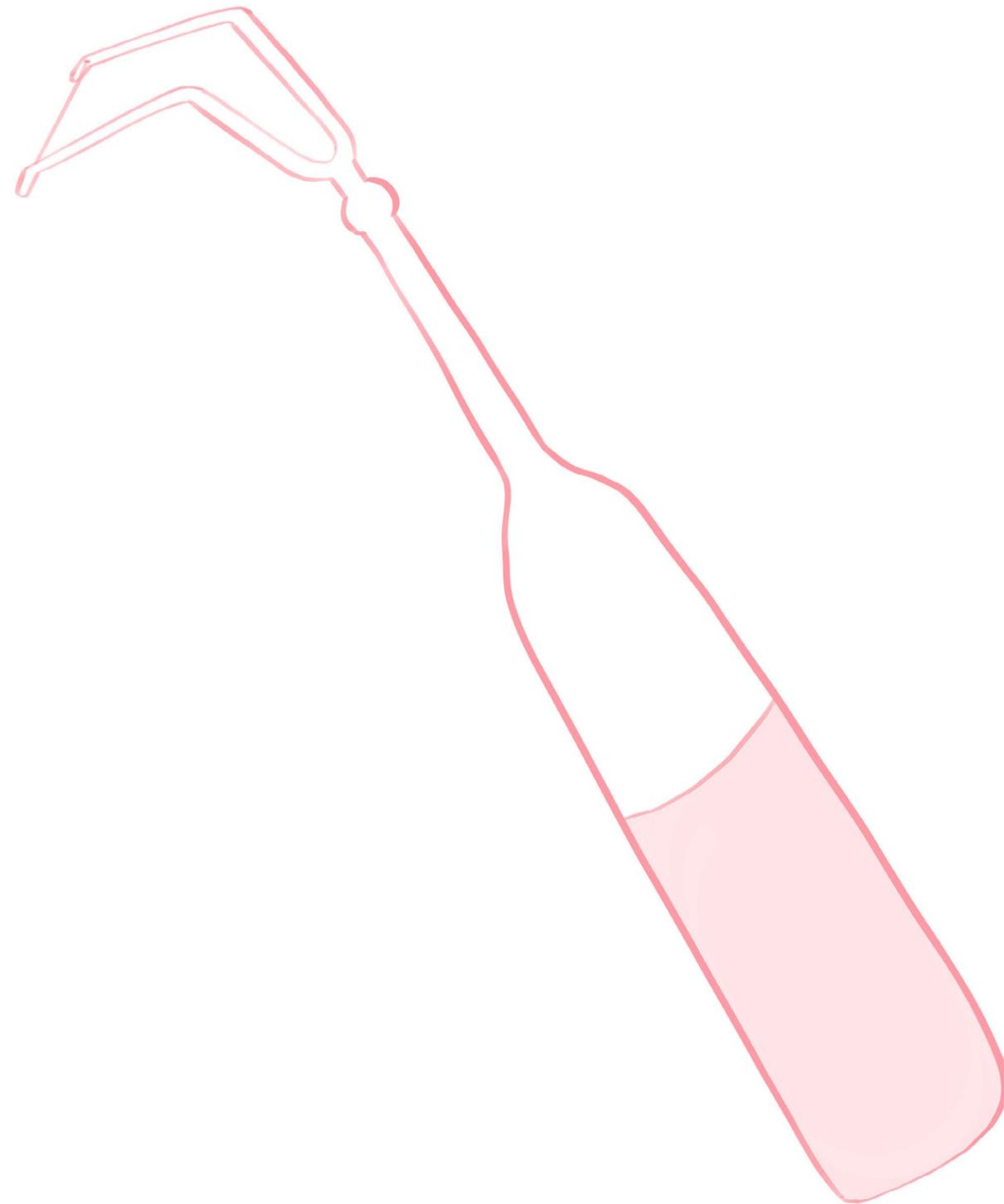
# 1.11 sketches



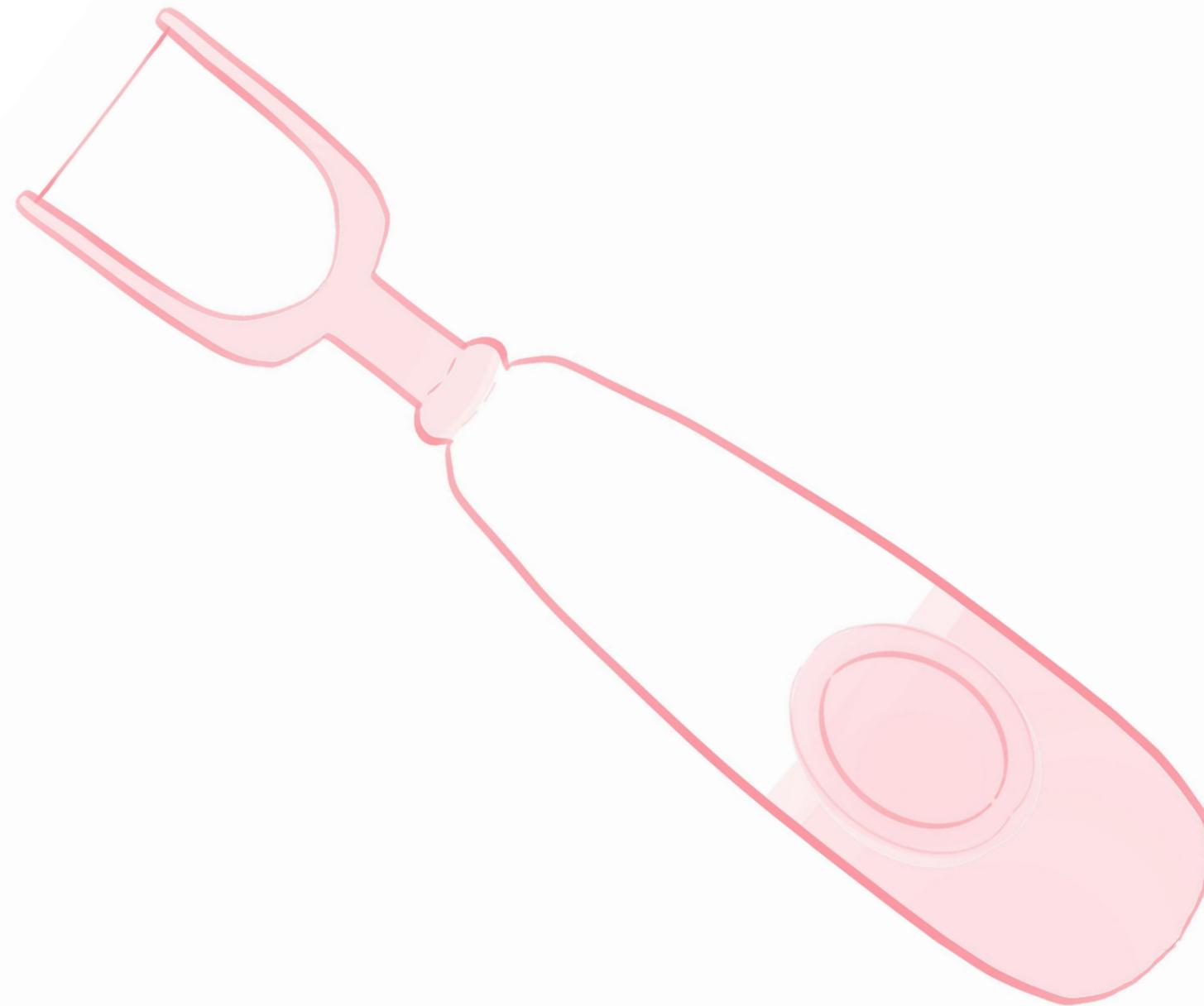
# 1.11 sketches



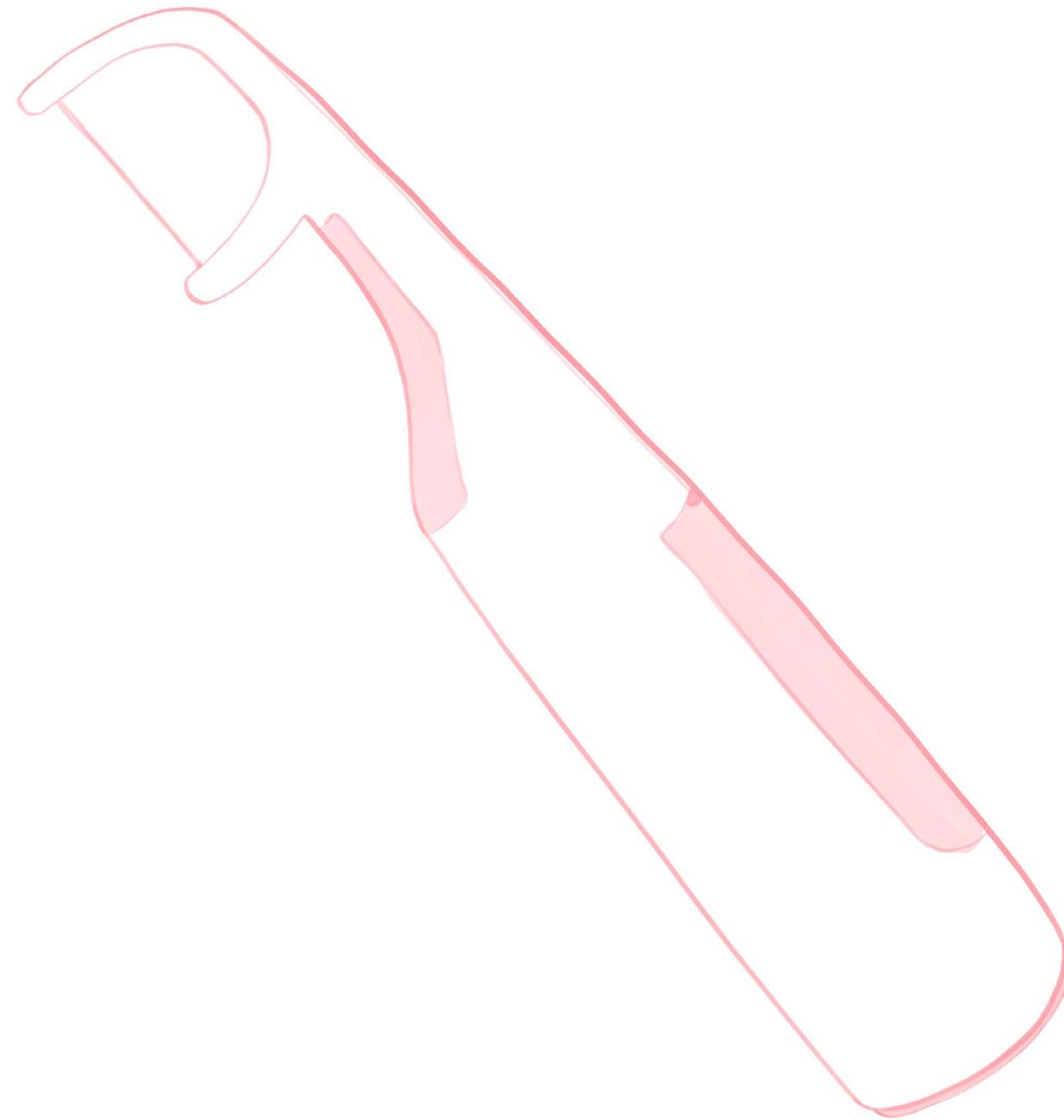
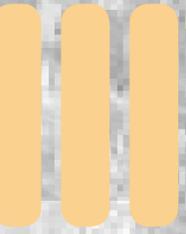
# 1.11 sketches



# 1.11 sketches



# 1.11 sketches



# 1.11 sketches

