

Introducing the first ever Philips Cast Cutter.

Bridging the gap between consumer and medical products, Philips' first ever cast cutter reduces the fear for children and improves the user experience for physicians. Its soft and subtle form combined with sharp detailing and attention to detail is where precision meets approachable.

innovation  you



PHILIPS



01 | Design Brief

Problem

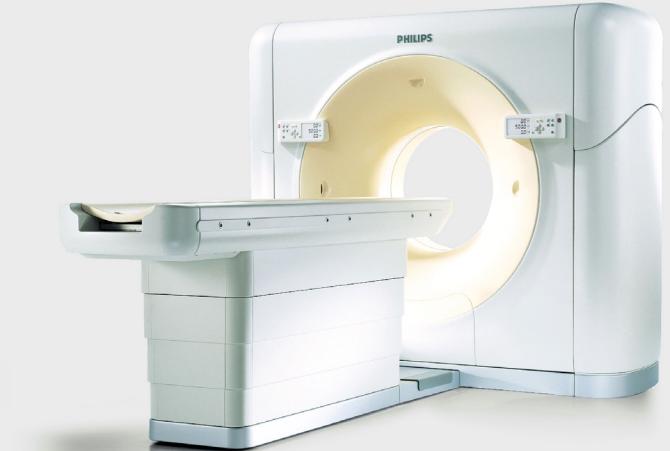
The **orthopedic cast cutter** has not changed much from its direct relative, the autopsy saw.

Problem

The whole process is **scary for children**
and **uncomfortable for physicians.**

Opportunity

With Philips' growing presence in the medical industry and their long lasting experience with consumer goods, the orthopedic cast cutter, being a hand-held medical tool, could be a product that merges those two interests.



Consumer

Medical

02 | Research

Stakeholders

Susan, 36

Susan has 8 years of experience as a **physician's assistant** at Advocare Orthopedic Center in Whippny, NJ.

She cuts anywhere between **5 to 10 casts in one day** and she feels it is **hard to control the depth** of the blade as it enters the cast.



The grip is a little wide,
especially for people with
smaller hands like myself.

Stakeholders

Sean, 7

Sean is a very active little guy. He spends his time during Fall on the **football** field and you can find him on the **baseball** diamond in the spring.

Last Spring, Sean **broke his wrist** during a baseball game. After going through the pain of the break and the long, annoying months of an immobile wrist, Sean then had to go through the **scary cast removal process**.



Current Market



Observation



- A.** Odd grip: Joystick-like
- B.** Used hose - still all that dust
- C.** Motor, hose, ergonomics

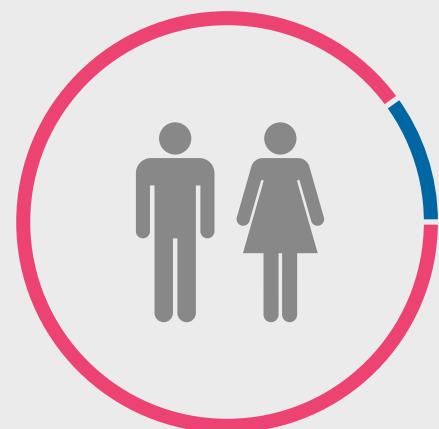
- D.** Uses finger as depth gauge
- E.** Shows patient it can't cut her
- F.** A lot of strain on both hands

- G.** Uses finger as guide
- H.** Trained at Advocare to do this
- I.** Two hands to control depth

- J.** Holding by the blade/hood
- K.** Plastic slip guard under cast
- L.** Very forward hand placement

Survey

It was important to get feedback from the physicians and the PA's so a survey was sent out to many orthopedic offices in order to see who is using this tool, how often, and what's most important to them as a user.



GENDER

Female	90%
Male	10%



CAST REMOVALS

1-10 a week	40%
1-5 a day	10%
5-10 a day	40%
10-15 a day	0%
15+	10%



VACUUM EFFECTIVENESS

1	0%
2	0%
3	70%
4	30%
5	0%



VACUUM DISPOSAL

2-3 weeks	0%
1-2 months	0%
3-4 months	40%
6-12 months	20%
Not Sure	40%



IMPORTANCE

Ergonomics	4.70
Vacuum	2.70
Depth Control	3.10
Weight	2.90
Speed Control	1.60

What they don't like ...

"The **blade** can get very warm and can burn the skin which is not safe especially for pediatric patients." - Survey No. 1

"The **grip** is a little wide, especially for people with smaller hands." - Survey No. 2

"**Loud noise** makes cast removal **scary for children.**" - Survey No. 3

"I like the **smaller handle** on the Stryker vs. the Delta Cast Cutter; it **allows for better grip and greater control!**" - Survey No. 4

"The Delta Cast Cutter is **bulky and difficult to grasp**. I have to keep re-adjusting my grip." - Survey No. 6

"**Difficult to control the depth** of how far the blade enters the cast." - Survey No. 7

"**Heavy, not easy to grip, stiff hose, hard to put it at different angles for cutting.**" - Survey No. 9

"The kids are often **more frightened by the sound than the blade.**" - Survey No. 10

What they want . . .

"I would **change the canister disposable to a bag** (like a vacuum bag) so I can **change it weekly and make sure it can have better suction.**" - Survey No. 1

"More of an **appearance geared towards pediatric patients** (i.e. looks like an animal)." - Survey No. 8

Easier blade change / Add grips to the handle - Survey No. 5

"Make the **handle smaller** so it fits comfortably in your hand. **The vacuum hose is also quite large.**" - Survey No. 9

Slimmer handle / Lighter weight / Smaller hose for easier angles while cutting - Survey No. 8

Smaller hose or eliminate the hose - Survey No. 10

Slimmer handle / Lighter weight - Survey No. 2

Lighter weight - Survey No. 3

Lighter weight / more ergonomic grip / more portability - Survey No. 6

Slimmer handle / Reduce noise - Survey No. 7

Reduce noise - Survey No. 4

First Person Insight

Advocare Orthopedics was nice enough to host me for a day and let me shadow some of the physician's assistants. One of the PA's was brave enough to let me cut a cast off of her to give me first hand, user experience.



Pain Point

For a safe cast removal, doctors use their **index finger as a depth gauge** for better control while cutting.

Clutter

When removing so many casts a day, it is **easier to just leave the hose out** instead of constantly stowing it away.

Pro Hack

Before rotating to a fresh edge, use a Sharpie to indicate the dull side of the blade.

Areas for Improvement

Between the loud noise and the huge, exposed blade, getting a cast off can become any child's worst nightmare. I set out to pinpoint problematic areas that need attention.



- 1** **Dust Collection**
The cast vac is loud, untidy, and cumbersome.

- 4** **Scale**
It is difficult to maneuver into the optimal cutting position.

- 2** **Blade**
Huge, completely exposed, and difficult changing process.

- 5** **Power Switch**
Rear location requires two hands to power on.

- 3** **Exposed Finger**
Constant contact with fiberglass casts results in blisters.

- 6** **Vacuum Hose**
Vacuum hose attachment is unwieldy and gets in the way.

Design Goals

After verifying the perceived problems with the physicians through the use of a survey and a visit to a local orthopedic office, I decided to focus my design on these five goals.



COMFORTABLE

In order to increase efficiency and comfort for the physician, excellent ergonomics are a must have for the cast cutter.



EASY / INTUITIVE

The blade changing process should be easy and intuitive. Mid-cut blade rotation also needs to be considered to maximize efficiency



MANEUVERABLE

The current system is very unwieldy. The cast cutter should accommodate various optimal cutting angles and positions.



APPROACHABLE

The cast cutter should be friendly and approachable to minimize the fear pediatric patients often experience.



SAFETY

Safety (and the perception of) needs to be highly considered as cast removals are often very scary for pediatric patients.

Philips Form Language

The Philips cast cutter draws inspiration from the merging of the sophisticated, precise design language of their consumer products with the softer, more approachable aesthetic of their medical devices.



Approachable / Precise

Precise parting lines and hard edges break up the soft and subtle form.



Isolated UI

The UI sits undisturbed on a segmented panel in order to call attention.



Touch Points

The desaturated yellow calls attention to the areas of interaction in a soft and approachable manner.

Engineering Inspo

Multiple trips to Target and Home Depot were essential to gain inspiration for features, form, and style.



Detachable Head

Could the cutting head be replaced with a vacuum head for post procedure clean up?



Form Inspo

Could the dust collection run through a channel below the knuckles to make the grip area thinner?



Depth Gauge

Could a spring loaded rotational blade guard help the physician control their depth?



Segregated Head

Could the blade housing be segregated yet still feel cohesive as a form like this shaver?

Internal Vacuum Research

In order to better understand the mechanics and the possibility of an internal vacuum. Jamie Kennedy, an engineer at Farm Design, was nice enough to share some Remington shaver prototypes with me.



Remington Shaver

I referenced the Remington Shaver to better understand how internal vacuums work.



U-Shaped Filter Canister

The filter canister hugs the motor which controls the impeller that creates suction.



Maximized Filter Canister

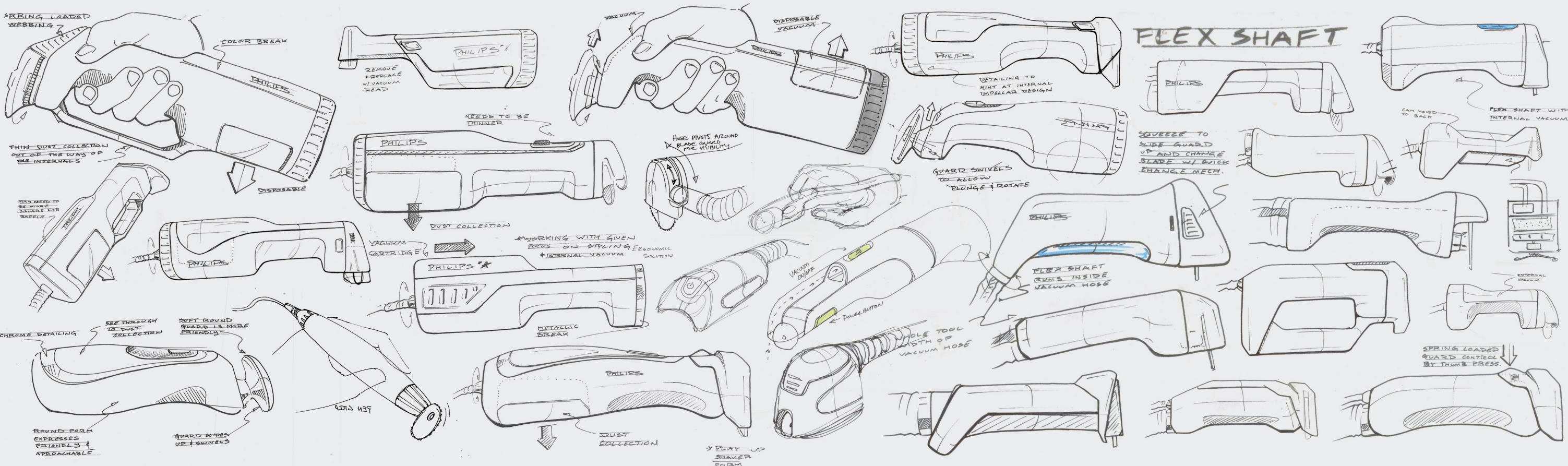
This method would require two motors. One for the impeller and one for the blade.



03 | Design

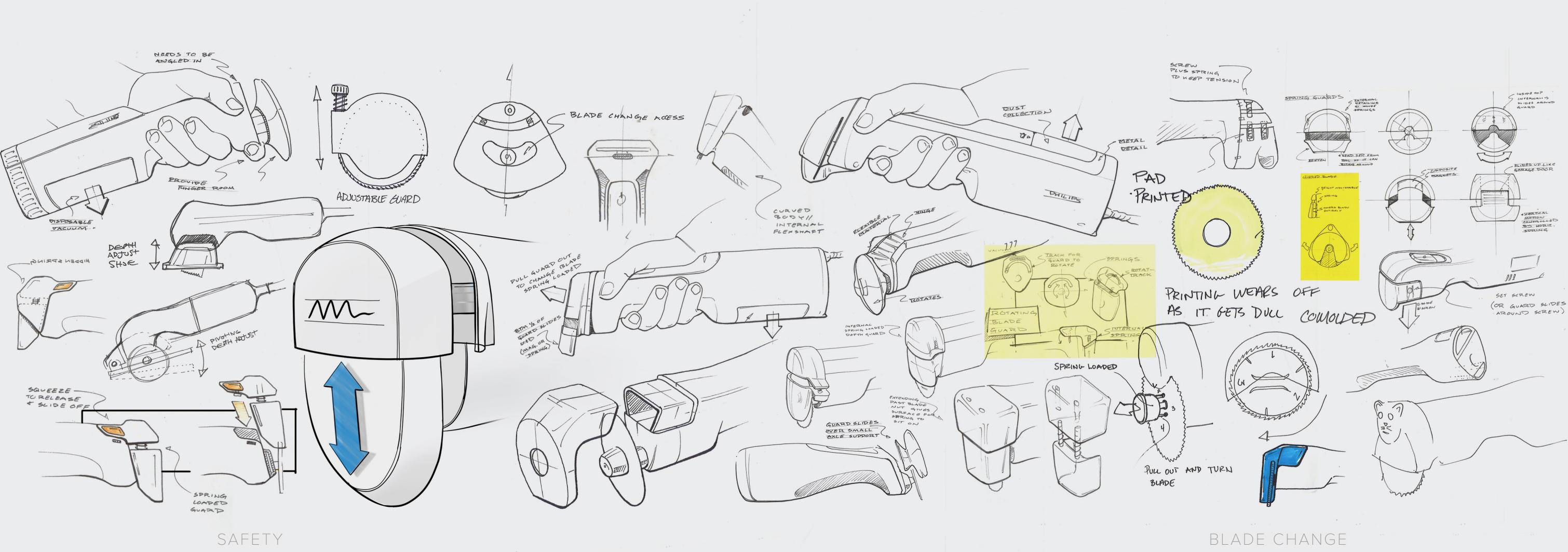
Brainstorm

The ideation phase began with overall form exploration as well as different ways to remove a cast in order to address the issues of scale and maneuverability.



Brainstorm

Throughout the ideation phase, important details regarding safety were explored as well as how to make the blade change process more intuitive.



Potential Directions

Following the ideation phase came the realization that the system as a whole could be explored in three directions.



Radically Change

The use of a **flex shaft** would significantly decrease the size of the cast cutter providing more opportunities for an **improved ergonomic design**. If the tool can't be cordless, it may be beneficial to at least make it smaller.



Work with Given

While keeping the **current system**, improvements can still be made to the design of the cast cutter through **ergonomic** and **safety** considerations as well as different features regarding **cord management**.

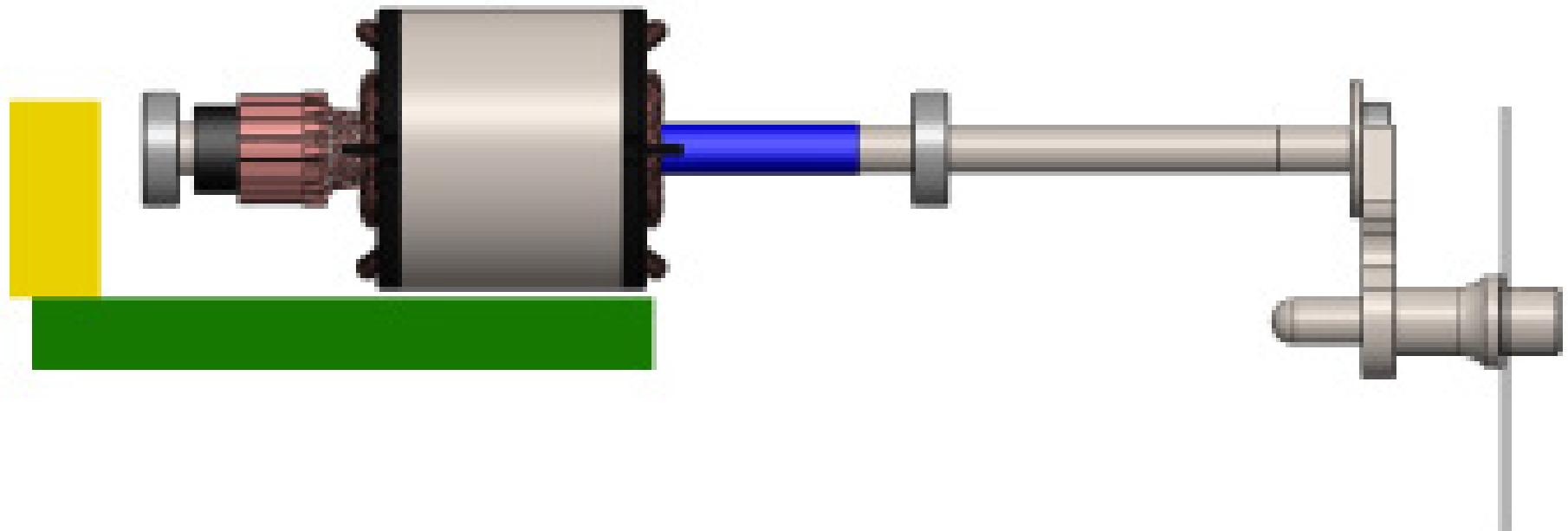
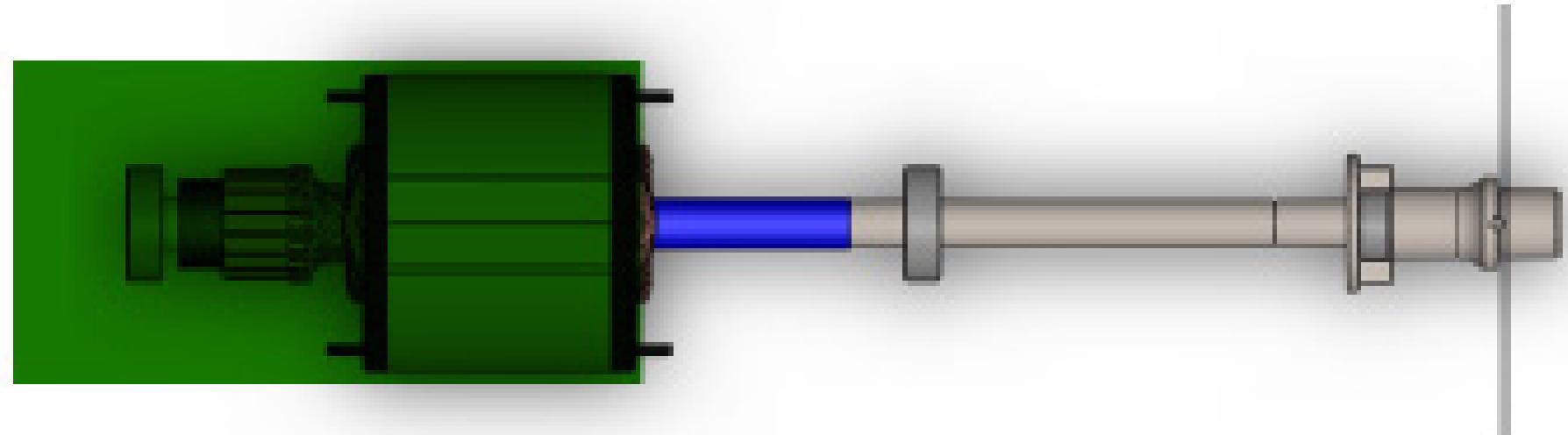


Focus on Portability

Using an **internal vacuum** may add another step to the procedure from the nurse's perspective but it could significantly **reduce the amount of noise** that the current shop-vac style dust collection is causing.

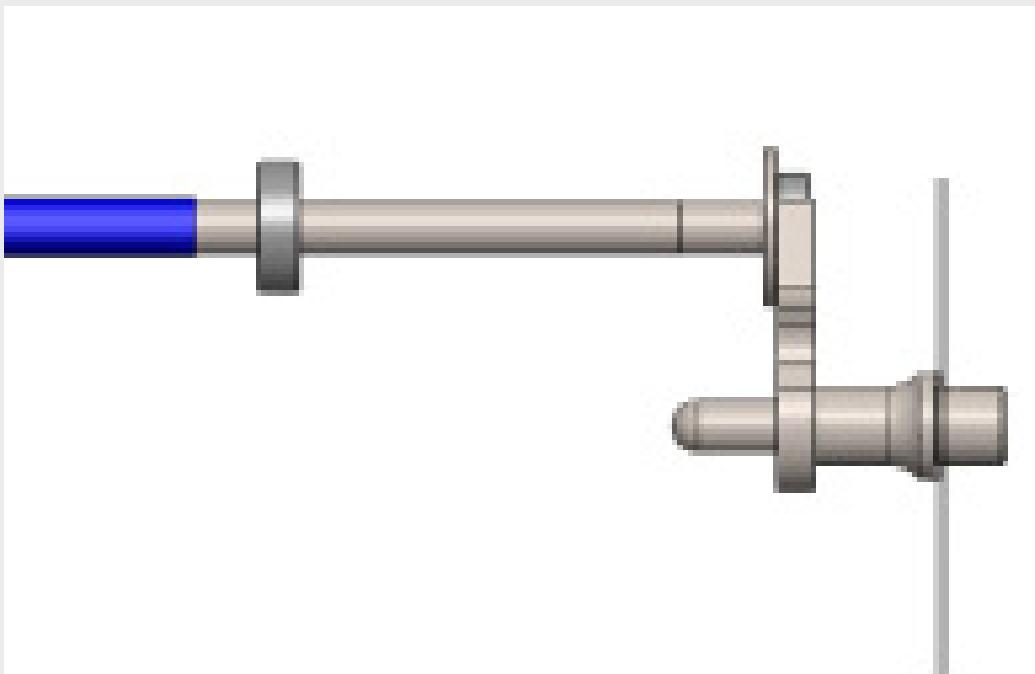
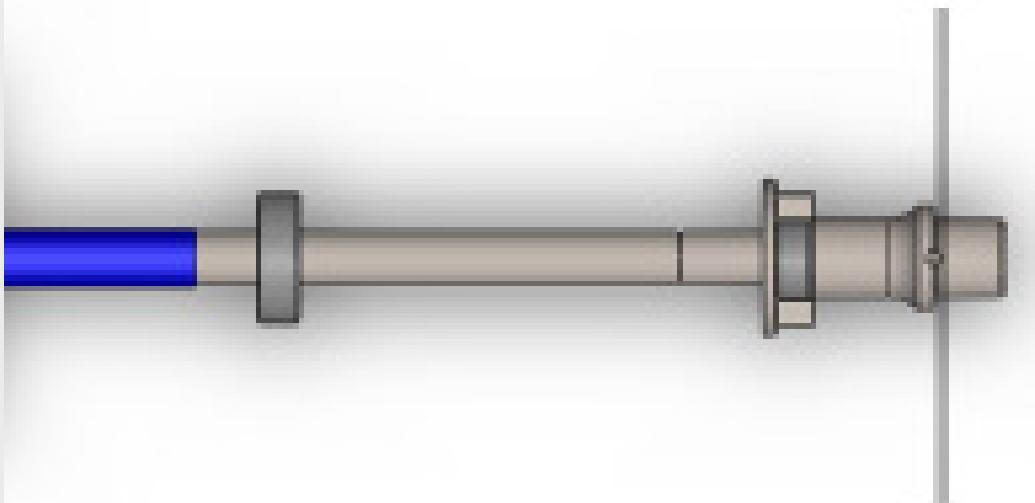
Internal Architecture Exploration

Standard



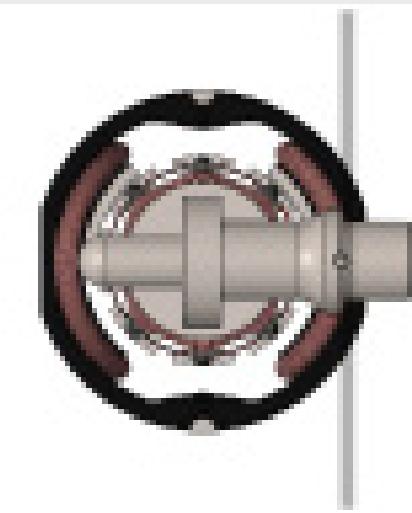
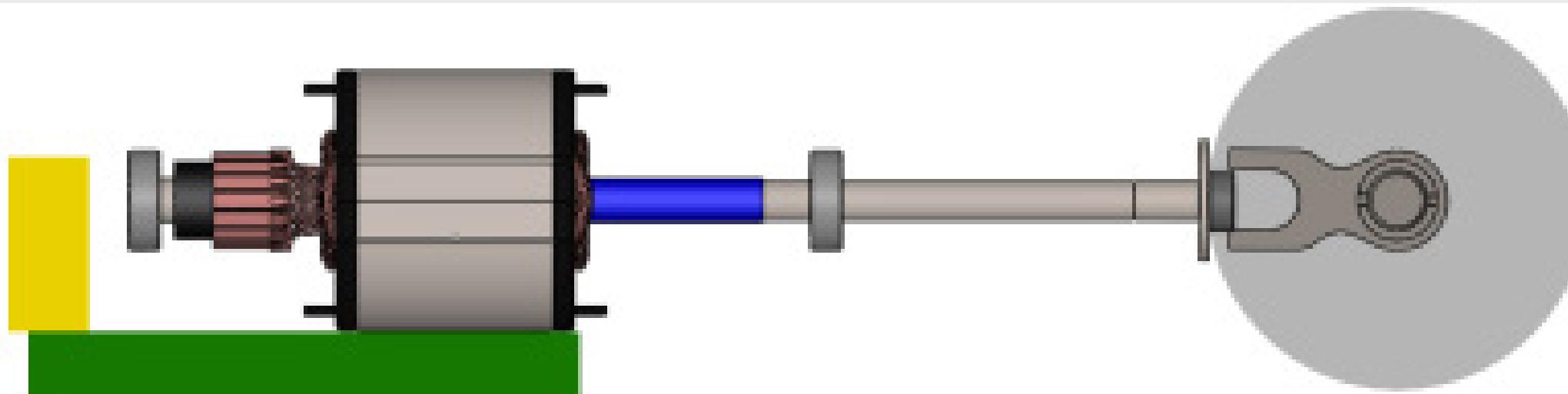
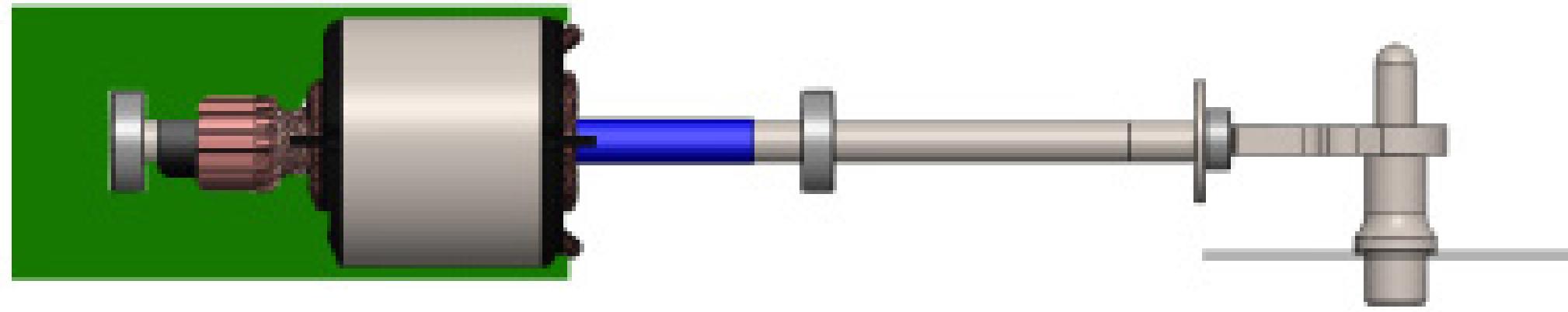
Internal Architecture Exploration

Flex Shaft



Internal Architecture Exploration

Circular Saw



Initial Form Studies

Three foam models were roughed out in order to visualize how different internal architectures affect the form in terms of scale and maneuverability.



Concept Down-Selection

By scoring each potential concept along a list of given criteria established from both user feedback and observational research, I was able to validate decisions moving forward as to which solutions were the best.

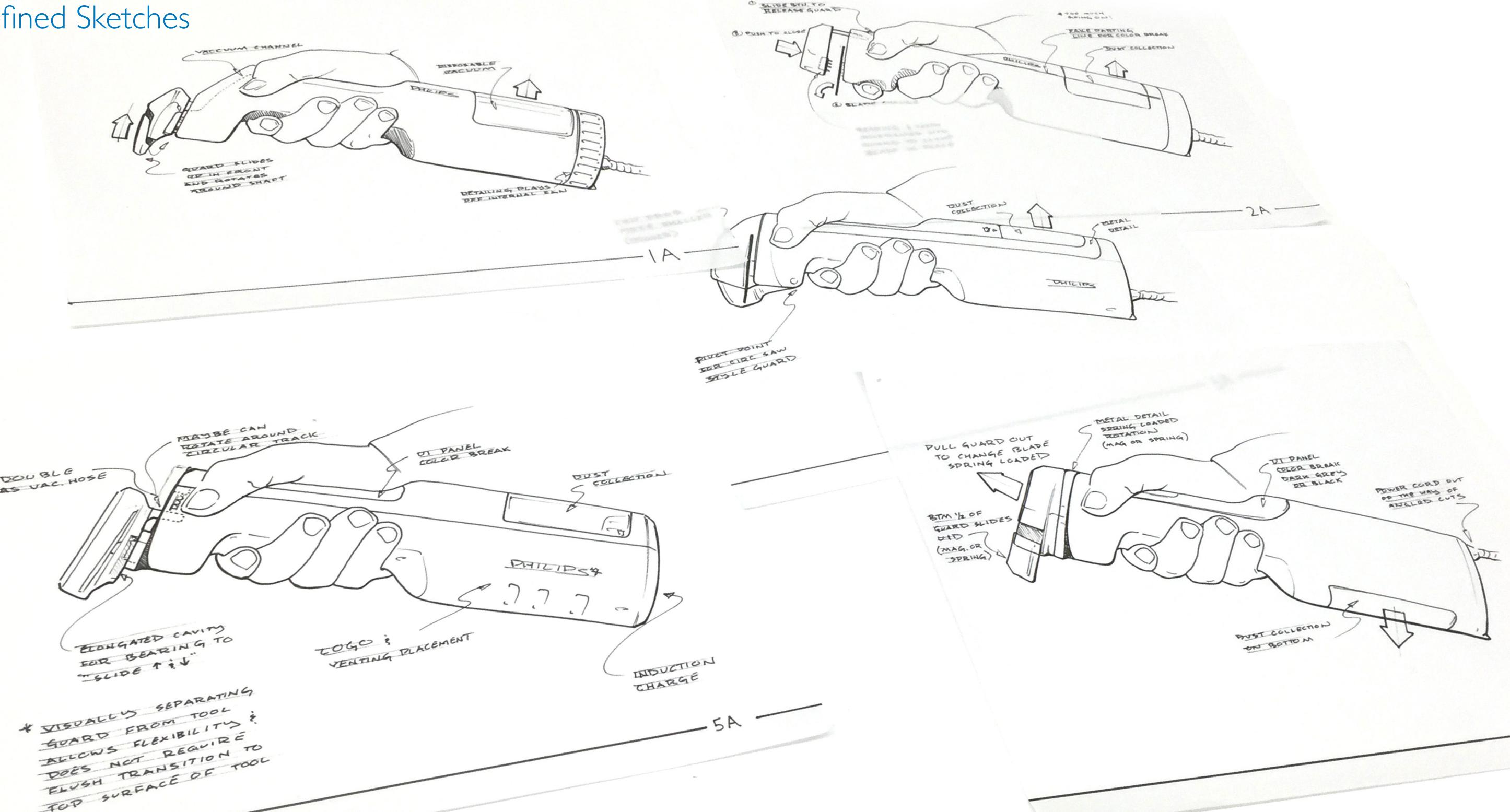
Criteria	Ergonomic	Depth Control	Weight	Easy / Intuitive	Maneuverable	Visually Safety	Noise	Total
Internal Layout								
Standard	2.0	-	2.0	-	2.0	2.0	2.0	10.0
Flex Shaft	3.0	-	3.0	-	2.5	2.5	2.0	13.0
Circular Saw	2.0	-	2.0	-	1.5	2.0	2.0	9.5
Portability								
Internal Vacuum	2.0	-	2.0	-	3.0	2.0	3.0	12.0
Rechargeable Battery	2.0	-	1.0	-	2.0	2.0	2.0	9.0
Blade Guard								
Multiple "Shoes"	-	2.5	-	1.0	-	2.5	-	6.0
Slip Guard	-	3.0	-	1.5	-	2.0	-	6.5
Floating Guard	-	2.0	-	2.0	-	3.0	-	7.0
Spring Guard	-	3.0	-	3.0	-	3.0	-	9.0
Adjustable Hard Stop	-	2.0	-	2.0	-	3.0	-	7.0

Concept Down-Selection 02

Not totally convinced that the flex shaft was the strongest solution, weights were added to the different criteria to tally up a total score. With such a close result, the famous saying “**Most advanced yet accepted**” sealed the deal.

Criteria	Ergonomic	Depth Control	Weight	Easy / Intuitive	Maneuverable	Visually Safety	Noise	Total
Weight	3	2	1	1	2	2	3	
Flex Shaft								
Base Line	3.0	-	3.0	-	2.5	2.5	2.0	
Spring Guard	-	+	-	-	-	+	-	
Easy Blade Change	-	-	-	+	-	-	-	
Total	9.0	2.0	3.0	1.0	5.0	7.0	6.0	33.0
Standard								
Base Line	2.0	-	2.0	-	2.0	2.0	2.0	
Spring Guard	-	+	-	-	-	+	-	
Easy Blade Change	-	-	-	+	-	-	-	
Internal Vacuum	+.5	-	-	-	+	-	+	
Total	7.5	2.0	2.0	1.0	6.0	6.0	9.0	33.5

Refined Sketches



Refined Models

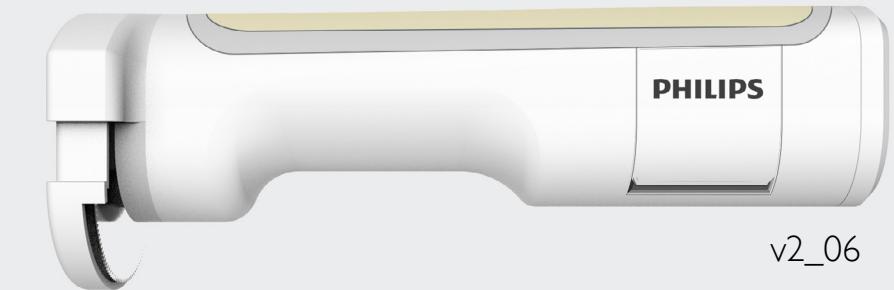
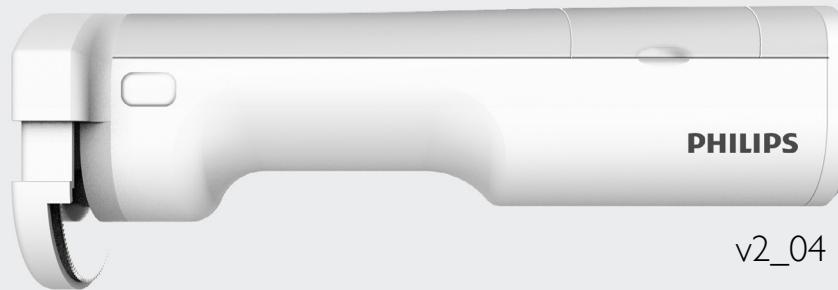
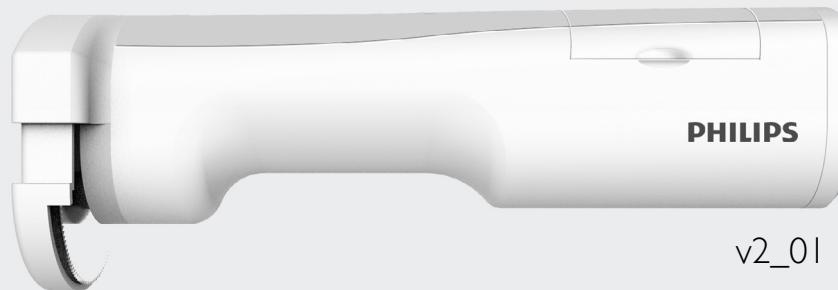
Bringing the general form into the 3D modeling space clearly helped create a more realistic model. By sculpting the shell as close as possible to the internal components, a more precise, and thankfully smaller, form was achieved.



04 | Development

Part Break-Up Exploration

After a final form was achieved, it was time to focus on the details. During the refinement stage, parting lines, vacuum canister location, logo placement, and the careful use of Philips' yellow were all explored.



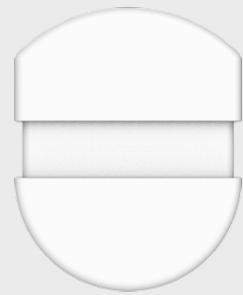
UI Exploration

Taking inspiration from Philips consumer products, a variety of UI concepts were created.



Guard Exploration

Many guard shapes were explored considering their appearance in both the open and closed positions. Ultimately a decision was made to match the shape to that of the “shield” profile present on the back of the device.



v4_01



v4_02



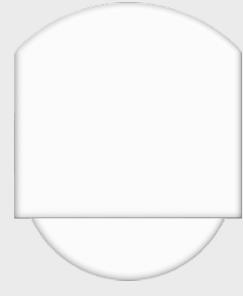
v4_03



v4_04



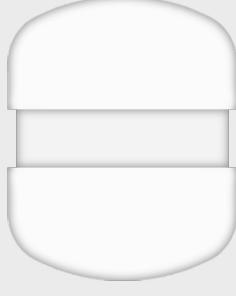
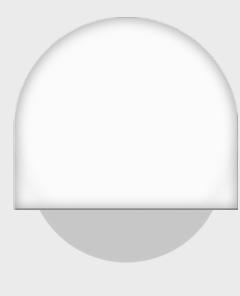
v4_05



v4_06



v4_07



v4_08



v4_09



v4_10



Guard Mechanism Prototyping

In order to validate the blade guard solution, 3D printing was utilized to create a functional proof of concept.

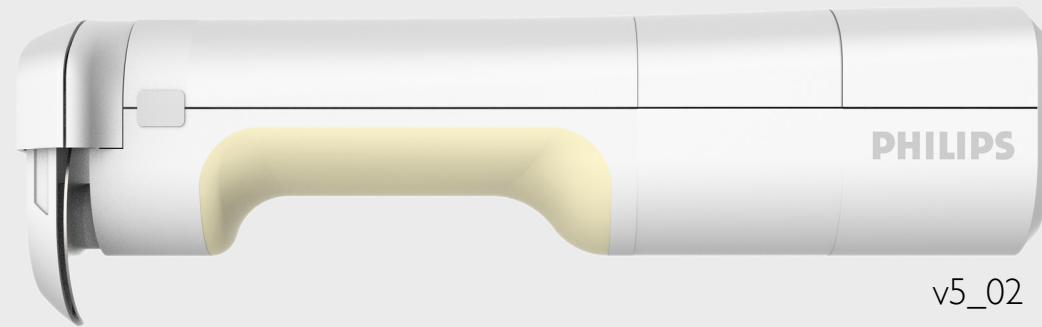


Vacuum Canister Placement

In order to keep the top surface clean and uninterrupted, the removable dust canister was moved to the bottom of the saw. This would certainly raise some eyebrows in terms of engineering but it's ideal for the aesthetic.



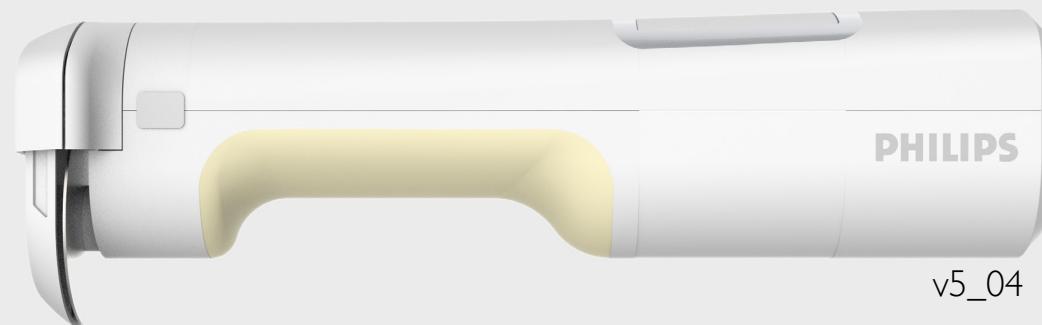
v5_01



v5_02



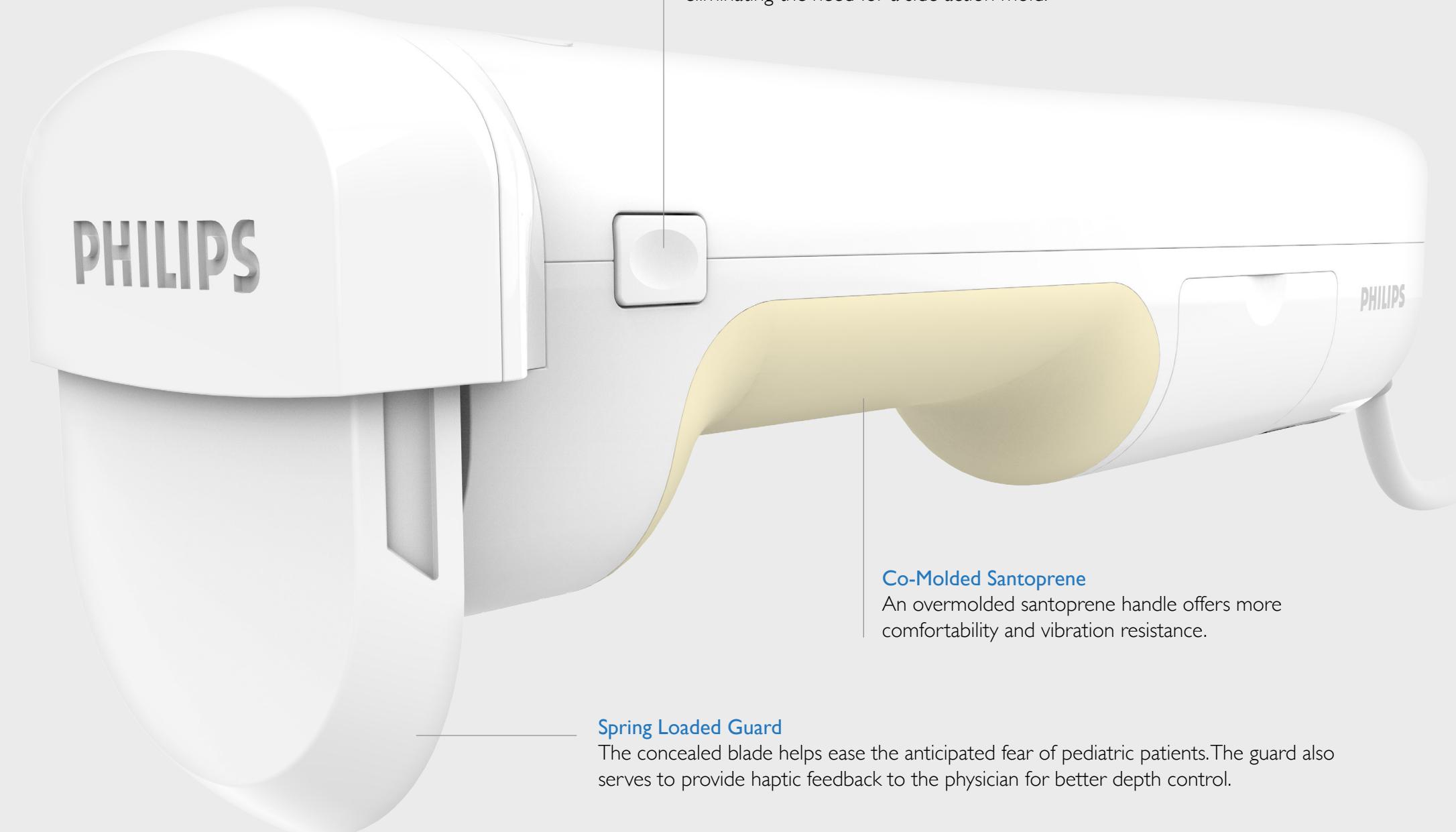
v5_03



v5_04

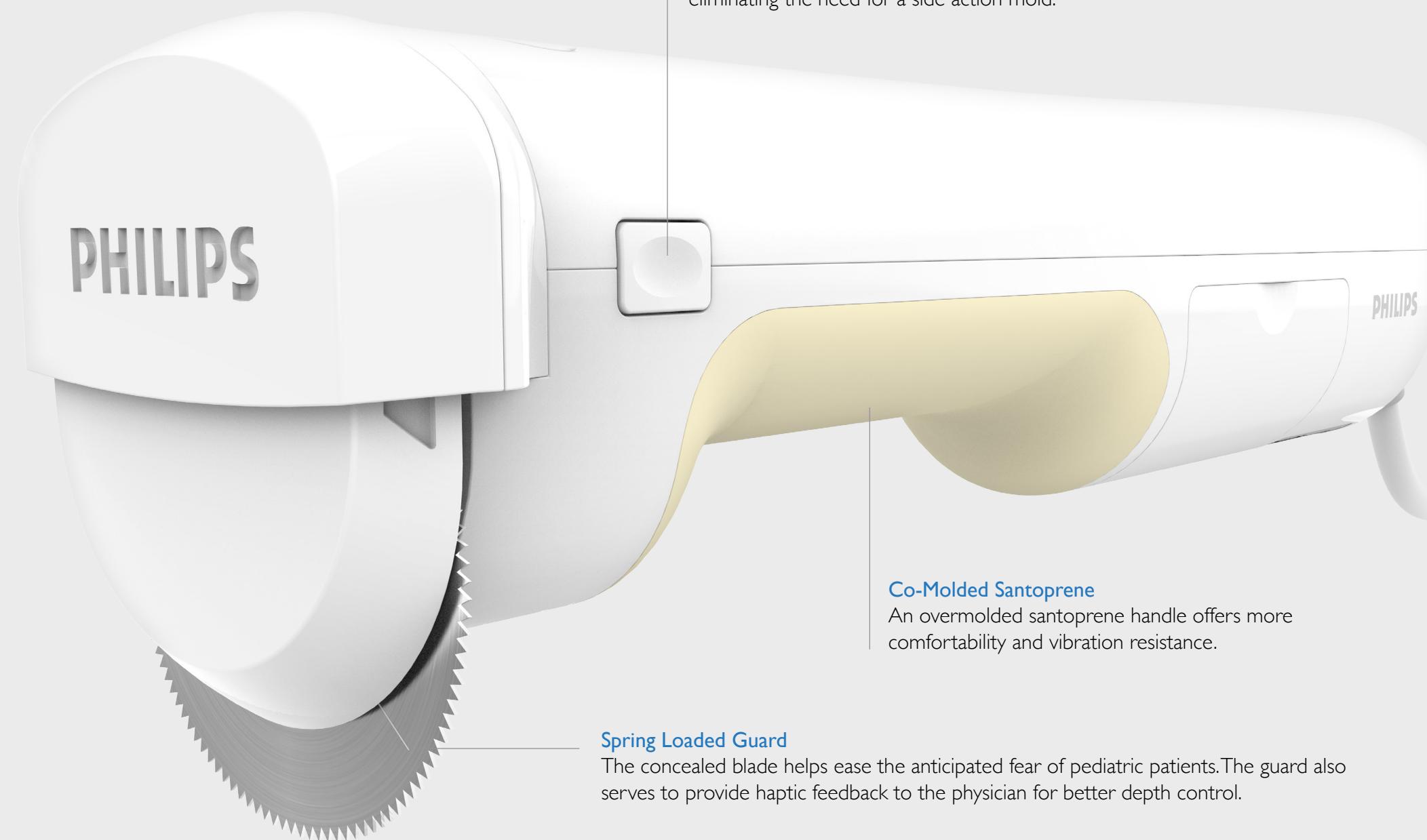
Final Design

The final design utilizes the Philips yellow to indicate primary touch points. An otherwise simple and clean form provides an approachable appearance appropriate not only for children, but adult patients as well.



Spring Loaded Blade Guard

The concealed blade helps ease the anticipated fear of pediatric patients. The guard also serves to provide haptic feedback for better depth control and the curved shape still offers the PA the ability to "plunge and rotate" as they have been trained.



Guard Release Button

The parting line runs through the center of the button eliminating the need for a side action mold.

Co-Molded Santoprene

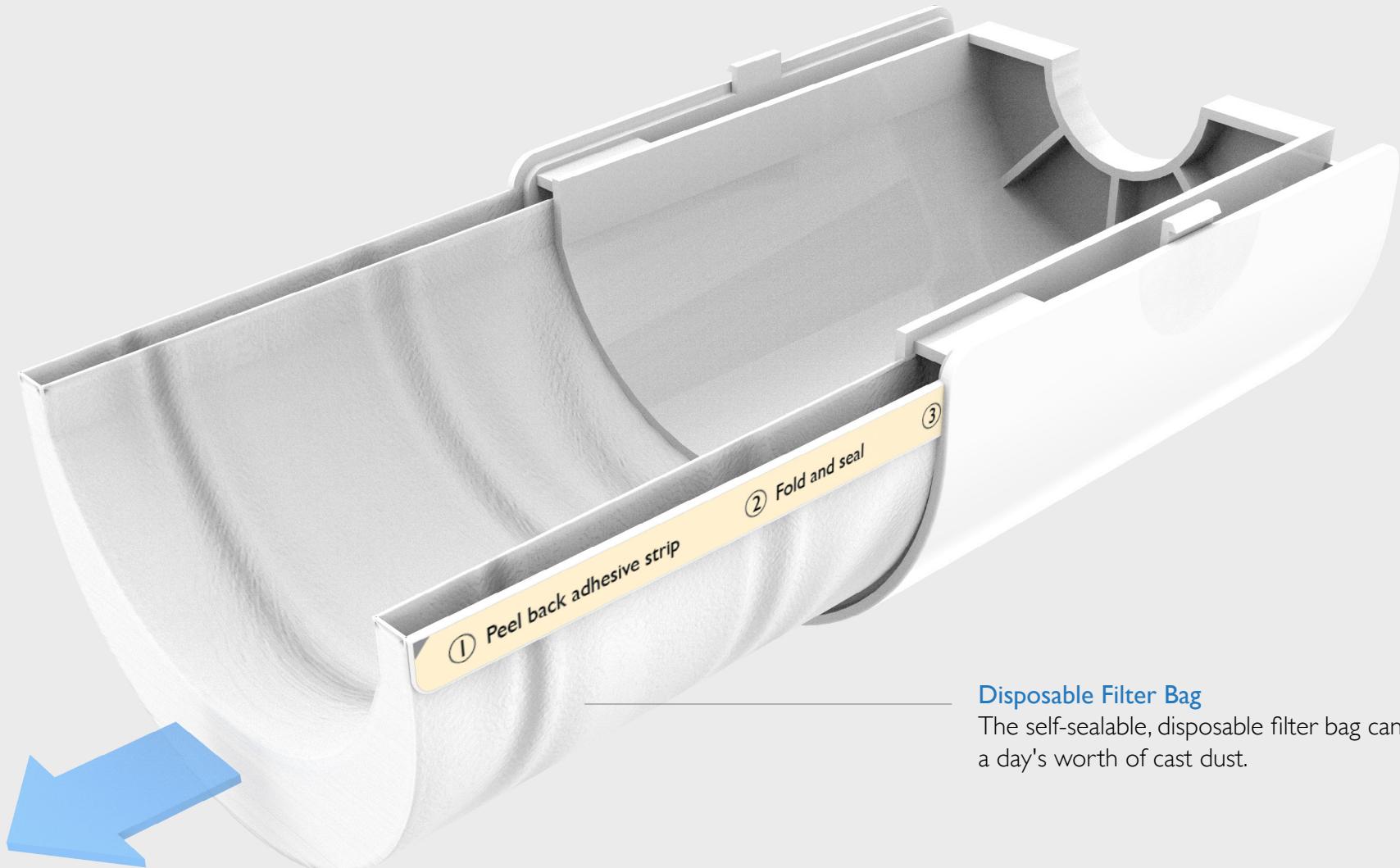
An overmolded santoprene handle offers more comfortability and vibration resistance.

Spring Loaded Guard

The concealed blade helps ease the anticipated fear of pediatric patients. The guard also serves to provide haptic feedback to the physician for better depth control.

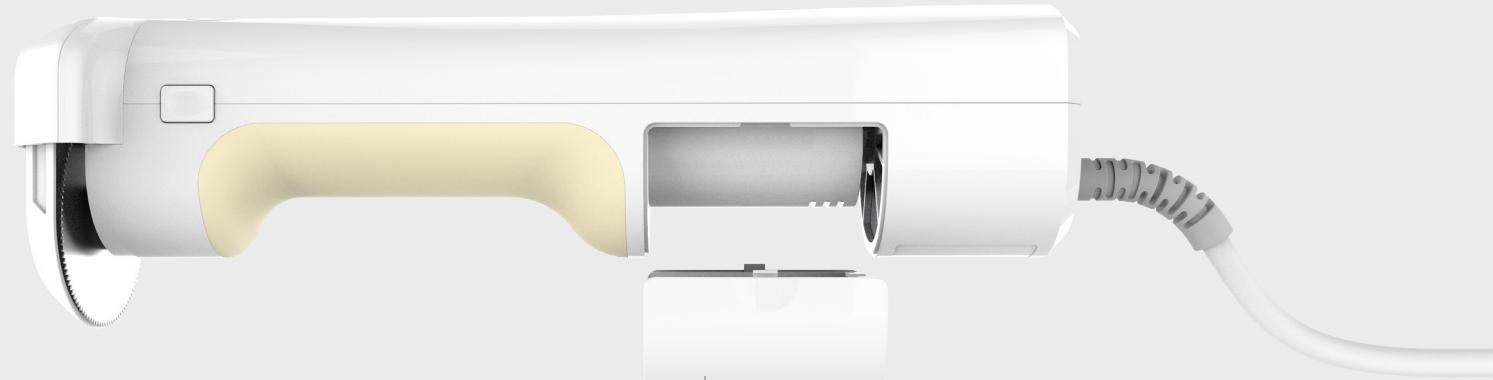
Internal Dust Collection

Children are often more scared of the noise than the blade itself. An internal vacuum heavily reduces the noise of the cast removal process by eliminating the shop vac style dust collection.



Disposable Filter Bag

The self-sealable, disposable filter bag can hold about a day's worth of cast dust.

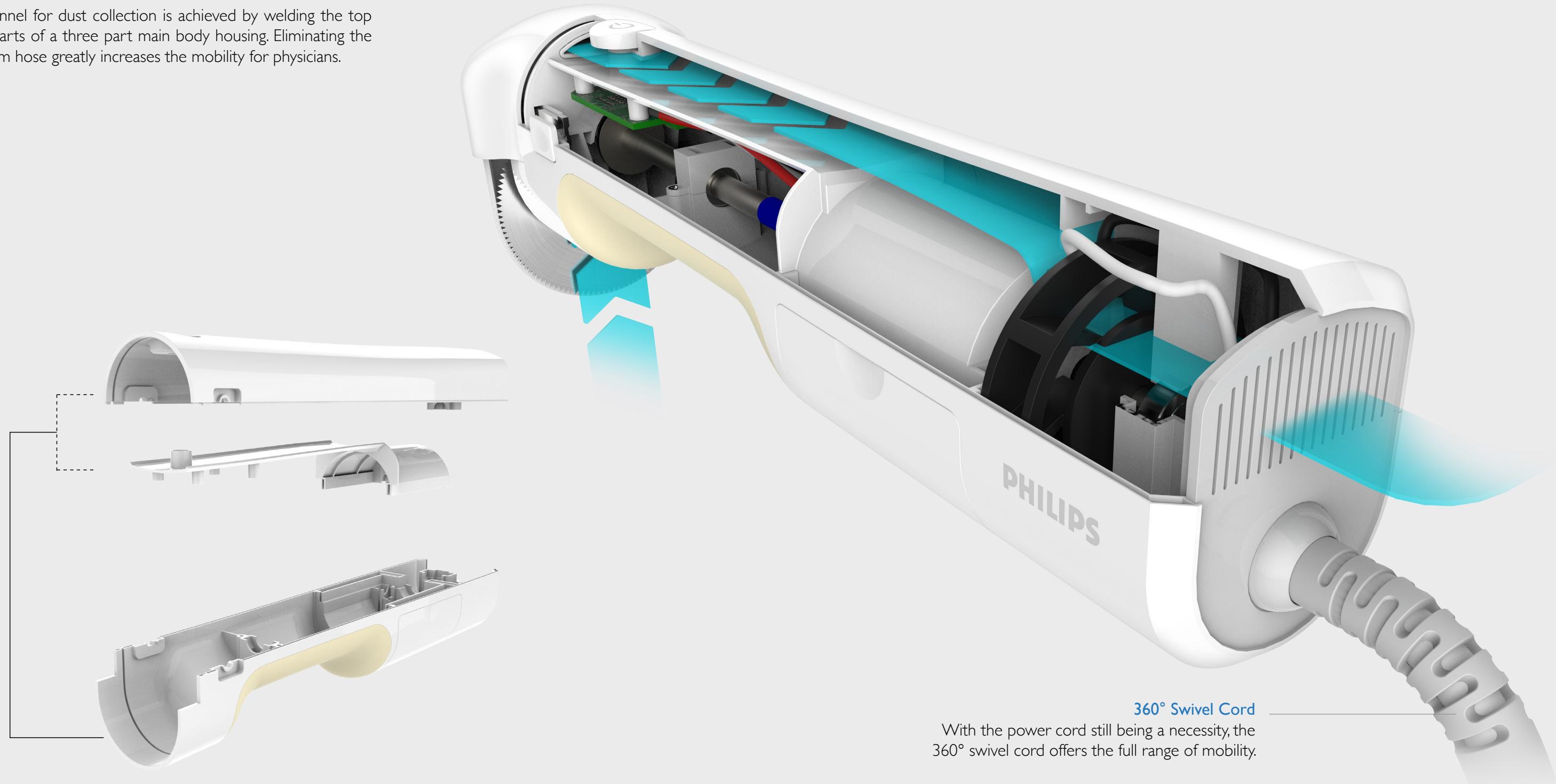


Vac Bag Housing

Using simple snap features, the vac bag housing is easily attached and removed from the cutter.

Internal Dust Collection

A channel for dust collection is achieved by welding the top two parts of a three part main body housing. Eliminating the vacuum hose greatly increases the mobility for physicians.



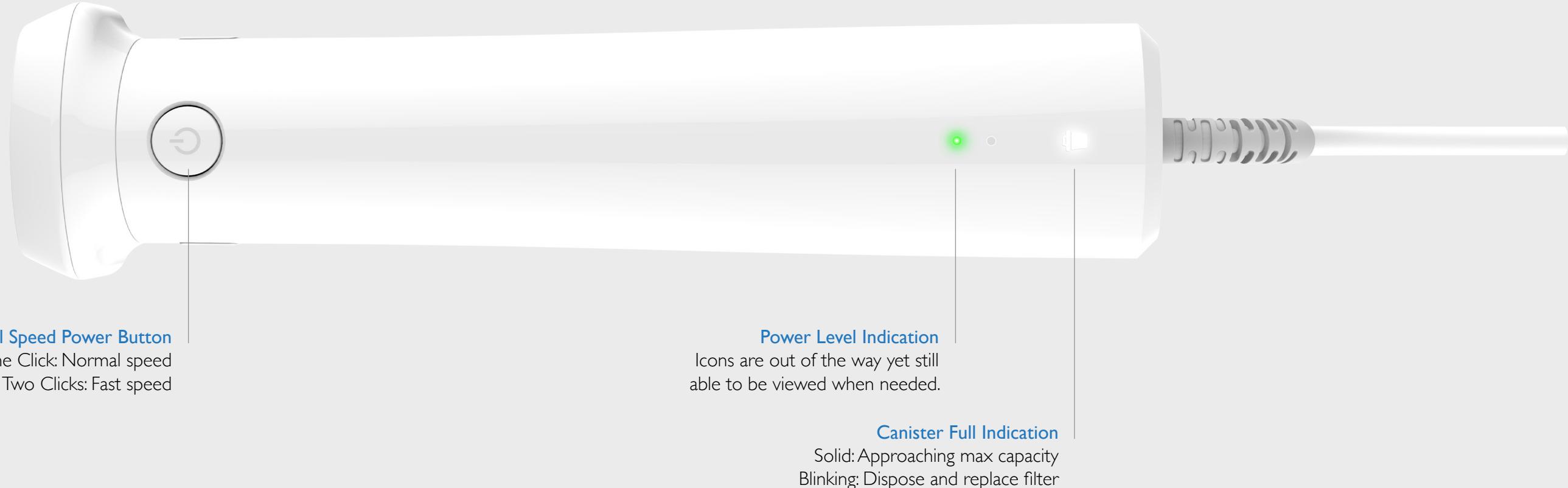
Mesh Filter

A mesh filter allows maximum air flow and suction while keeping dust out of the internal components.



Simple / Intuitive UI

The simple UI panel is free of any part breaks and extra detailing. Because the LEDs sit beneath the surface, a deadfront look is achieved when the indication icons are not active. This allows for a sleek and seamless surface that plays up the approachable aesthetic.



Dual Speed Power Button

One Click: Normal speed
Two Clicks: Fast speed

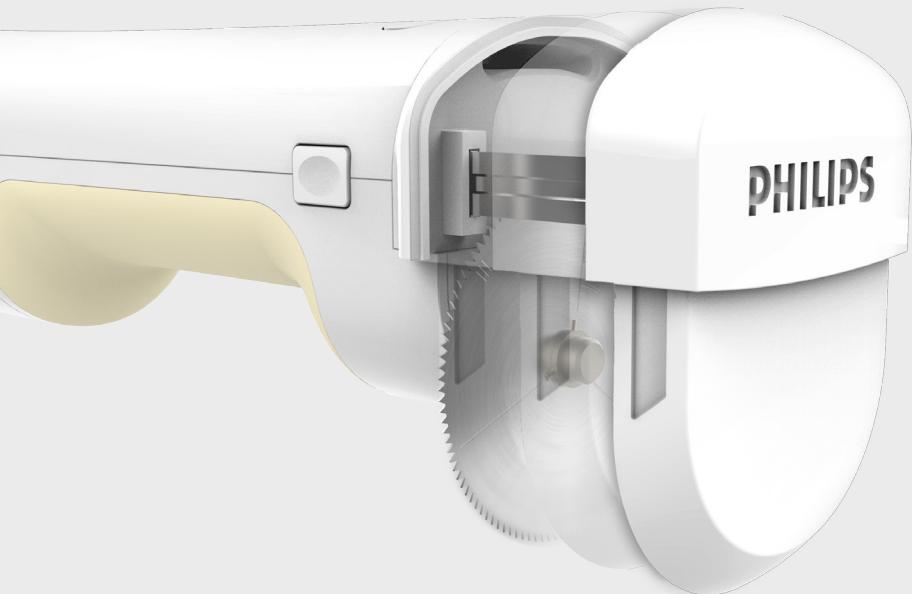
Power Level Indication

Icons are out of the way yet still able to be viewed when needed.

Canister Full Indication

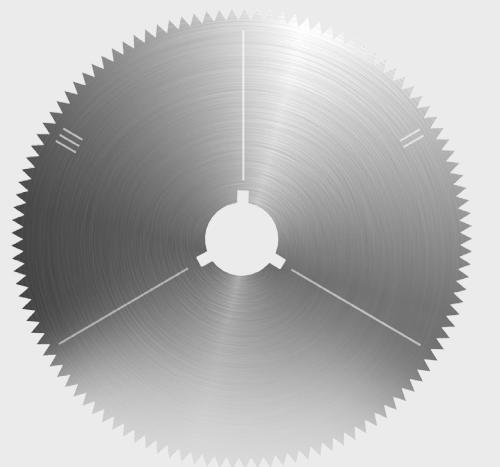
Solid: Approaching max capacity
Blinking: Dispose and replace filter

Toolless Blade Change Process



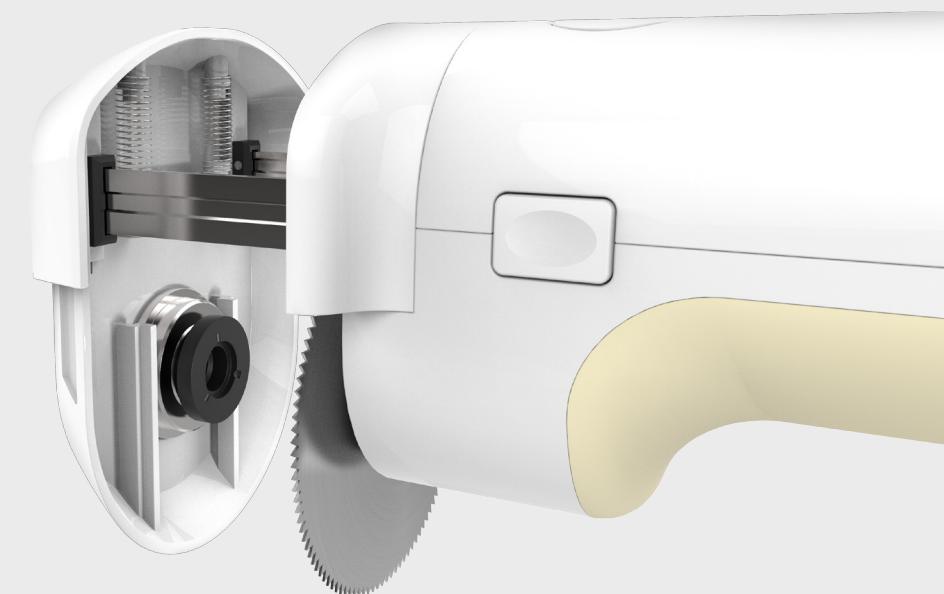
1 Open Guard

To rotate or change the blade, press down on the two buttons located on the side of the cast. The guard springs open allowing plenty of room for the removal of the blade. **No tools required!**



2 Rotate for Fresh Edge

Section numbers and division marks are **pad printed** onto the blade. As the blade cuts through the cast, the number wears away making it **easy for doctors to locate the next fresh edge.**



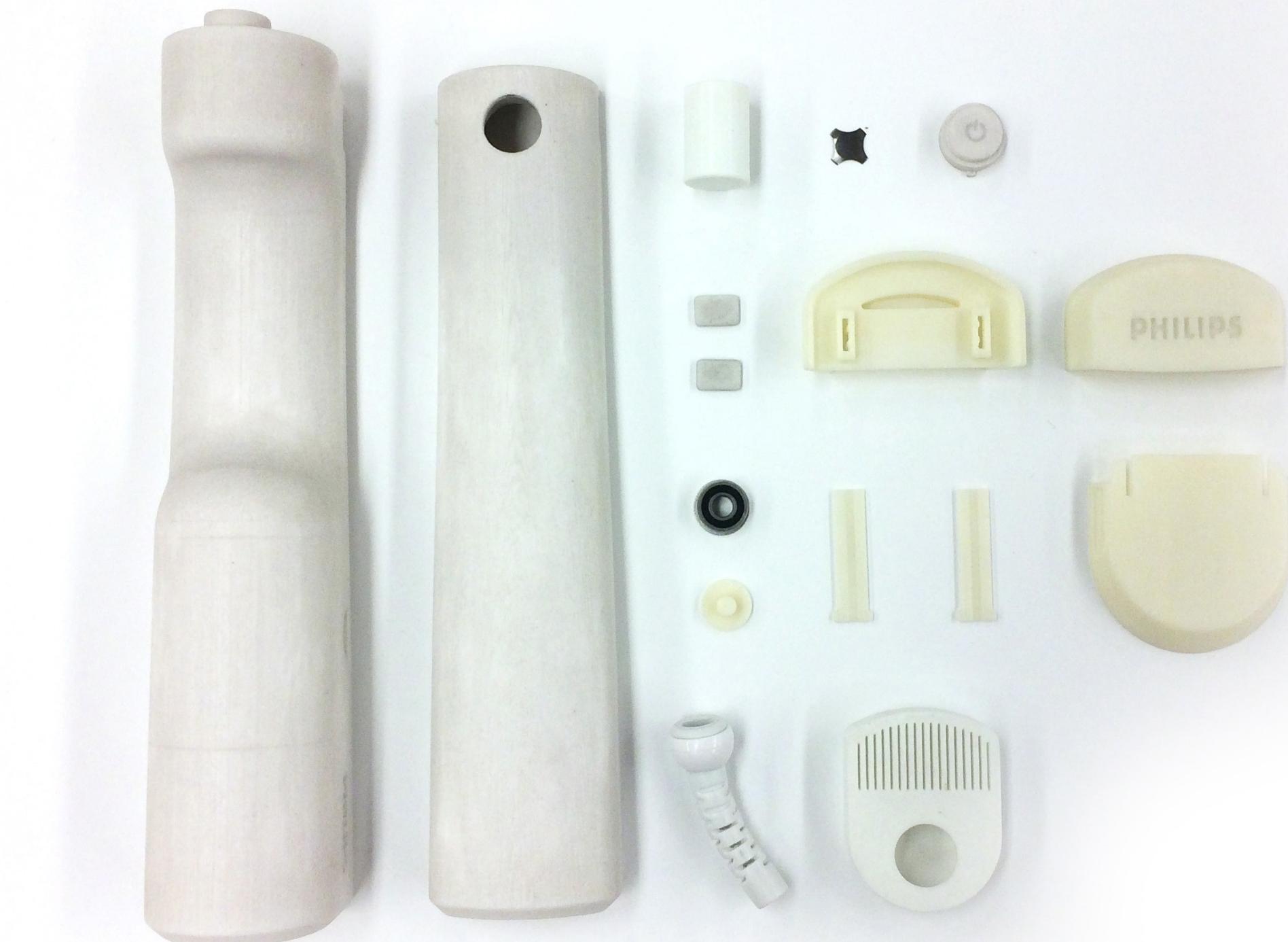
3 Close Guard

Insert the new blade or fresh edge onto the shaft and **with one simple push, the guard clamps the blade in place.** The floating flange bearing allows for both vertical and rotational movement.

05 | Physical Model

3D Printed Parts

The entire model was printed using both PLA and plaster. A valient effort was put forth to make the blade guard functional but fell short. The power button, however, is functional in order to provide the intended haptic feedback.

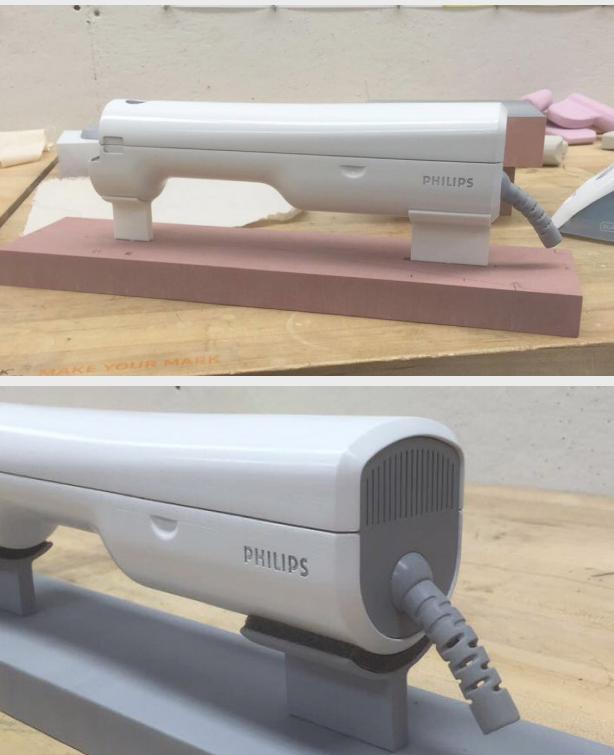


Painted Parts

The stand was created purely for display purposes and does not reflect the design intent of the stand that will be designed at a later date.



Assembly



Thank You!

Thank you to everyone who helped me through this project. To my classmates, Advocare Orthopedics, and the design team at Farm Design.