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Aesthetic Considerations in the Ortho-Prosthetic Design Process

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Medical products, including prosthetics and orthotics, are designed to partially or completely assist or replace the functionality of specific body parts affected by ailments or medical deformities. People using such devices share similar sensibilities and concerns, such as looking attractive or being able to wear fashionable clothing. However, due to a greater emphasis on function over fashion in designing these medical products, the aesthetic values of the user are not fully considered. This aesthetic paucity may have a strong psychological and cognitive impact, which affects the user experience. Hence, this study aims to explore key parameters affecting the aesthetics of medical products such as prosthetics and orthotics, and identify the challenges involved in their design process. Recommendations have also been suggested for the designers with the help of a design example.

Keywords: Aesthetics, Medical product design, Prosthetics & Orthotics design, User experience, User psychology

Introduction

The design of medical products is a huge industry worldwide, of which, a major interest has always been the design of orthotics and prosthetics. Orthotics are devices, which provide support or stabilize an affected part of the body. They are used in cases of reduced musculoskeletal functionality. In most of these cases, the orthotics are used as the external aid or body support (Sansoni, Wodehouse, & Buis, 2014). However, these supports can be used internally in the form of rods and braces. The most widely used orthotics include splints, braces, slings, compression sleeves, and insoles. There are some simple orthotic products that we use in daily life such as glasses or spectacles, but these have been transformed from simple disability products to a fashion icon (Pullin, 2009).

Prosthetic devices replace or enhance the functionality of a body part (Sansoni et al., 2014). They are used in cases of severe medical deformities or amputations. Other examples of prosthetic use include implants, artificial hearts and limbs. In previous studies, it is quite evident that the use of prosthetics not only aid the user by increasing mobility, but also helps in performing daily activities, thereby enhancing physical, social and emotional well-being (Murray, 2005; Pohjolainen, Alaranta, & Kärkäinen, 1990). The new science of "Prosthology" (Bache, 2008) deals with concept of the prosthetic part of the body being fully integrated as a new part of the body, as described by Gestalt's concept of totality (Giannini, Marzi, & Viggiano, 2011).

Limb amputation has many disturbing and irritating impacts on patient psychology (Horgan & MacLachlan, 2004; Whyte & Niven, 2001) often leading to stress and despair (Breakey, 1997; Williamson, Schulz, Bridges, & Behan, 1994). Product design studies (Bloch, Brunel, & Arnold, 2003; Creusen & Schoormans, 2005; Crilly,

Moultrie, & Clarkson, 2004) have suggested that the visual appearance of a product is one of the key elements affecting user choice and the product-user relationship. Visual aesthetics also have the tendency to make products more acceptable and effectively usable in many cases (Newell & Gregor, 2002) However this may differ across products and contexts. The overall appearance of a prosthetic limb is very important and may alter the level of the patient acceptance for the prosthesis (Biddiss, Beaton, & Chau, 2007; Cairns, Corney, & Murray, 2011; Carroll & Fyfe, 2004; Datta, Selvarajah, & Davey, 2004; Hagberg & Brånemark, 2001; Legro et al., 1999; Murray & Fox, 2002; Pillet & Didierjean-Pillet, 2001; Pons et al., 2005). However, in designing medical products, functionality is the designer's primary concern; with minimal attention given to product aesthetics. This can affect user experience and satisfaction. Most of the available literature is focused on the technical and functional aspects of prosthetics, with only a few studies dedicated on aesthetics, showing a lack of interest of designers and researchers in this area (Cheetham, Suter, & Jäncke, 2011; Klute, Kallfelz, & Czerniecki, 2001). In the case of hand prosthesis, a previous study (Kostuik, 1981) also describes a prioritization of functional usage over aesthetics . While, another study by Biddiss and Chau (2007) suggests prosthetic appearance to be a factor that significantly influences the decision to wear or use a wearable prosthetics. The decision of whether or not to wear a prosthetic may be based on the user's life style and personal needs (Durance & O'Shea, 1988; Hubbard, Kurtz, Heim, & Montgomery, 1997; Scotland & Galway, 1983; Wright, Hagen, & Wood, 1995). However, aesthetics play an important role in altering device adaptability. Additionally, if the prosthesis is purely functional but overly bulky, it can affect user acceptability and satisfaction. This can also have consequences which may affect the user's psychology state and social interactions skills (Bhuvaneswar, Epstein, & Stern, 2007). In order to avoid such situations, it is important to focus on the aesthetics of prosthetics.

Several studies have shown that the acceptability of medical products can be improved significantly by addressing their aesthetics (Goiato, Pesqueira, Ramos da Silva, Filho, & Micheline dos Santos, 2009; Newell & Gregor, 2002; Power, Leaper, & Harris, 2017; Sammartino, Marenzi, Di Lauro, & Paolantoni, 2007). However, a very limited number of studies (Nicola Cairns, Murray, Corney, & McFadyen, 2014; S Sansoni, Wodehouse, & Buis, 2014) have been conducted in the area of medical product design aesthetics. The majority of these studies have mainly focused on improving the aesthetics of upper and lower limb prosthetics (Davies, Rode, & Cywes, 1977). There is still a wide range of possible medical products, whose designs can be optimized by improving their visual appearance and aesthetic properties.

In this paper, the authors explore the field of medical product aesthetics. Some valuable suggestions and recommendations for medical product designers with the aim of improving user experience and satisfaction have also been discussed.

Customary design attitude of Ortho-prosthesis and need of aesthetics

Conventionally, medical personnel such as doctors, physiotherapists and prosthetists are typically involved in the ortho-prosthetics' design process in order to ensure functionality. In the case of prosthetics and orthotics, functionality is important for enhancing mobility and fundamental in performing activities of daily living. However, the aesthetic value of the product is generally neglected or only considered after the users functional requirements have been met (Gotzsch, 2000; Jordan, 2000; Lewalski, 1988; Maslow, 1970; Rutter & Agne, 1998; Viemeister, 2001; Yalch & Brunel, 1996). Functionality is often considered as the cutoff requirement in process of designing medical products unless the product have some clear marketing value based on fashion and styling only. As the industry shifts towards user-centered designs, user experience has gained considerable importance and mainstream designers are increasingly aware of the impact. Hence, medical product designers now need to focus on product aesthetics as well as functionality.

Today, we live in a world where bodily perfection and beauty are given a high priority. People who use medical products such as prosthetics encounter challenges related to aesthetics such as social validation and acceptance (Hughes, 2000). Often unacceptance based on image and aesthetics can cause feelings of social exclusion. Limb amputees face extreme difficulty in accepting new prosthetic modifications to their body (Sjödahl, Gard, & Jarnlo, 2004) which can often lead to depression. Prosthetic users tend to avoid public exposure and are more prone to social isolation due to feelings of awkwardness and being self-conscious. These behaviors can affect psychological wellbeing, self-esteem and the ability to interact in social situations. (Sansoni, Wodehouse, McFadyen, & Buis, 2015).

Design aesthetics play a significant role in changing user behavior and product preference. A designer from Reebok theorized the value of good design by stating that "good design can make you fall in love with the

product" (Dumaine, 1991). By improvising upon aesthetic features, users can have an opportunity to actively or to passively express themselves in their own unique way. Styling can enhance the acceptability of prosthetic usage among amputees by having positive psychological impacts. This can have positive effects on self-esteem and confidence. Hence, it is tremendously important to consider aesthetics when designing medical products.

Parameters of aesthetics affecting user experience

Incorporating natural elements in aesthetic improves the user experience and acceptance. Many designers have used natural and organic elements in the product design process such as those found previously in Art Nouveau (Weisberg & Menon, 1998). Organic elements not only mimic abstract human forms but can also be used as a stylistic element when designing prosthetics. Due to the level of craftsmanship and material handling involved, natural forms were considered to be difficult to manufacture. However, with emerging technology and ease of use of techniques like 3D scanning, modeling and printing, it has become possible to design and customize aesthetically pleasing medical orthotic and prosthetic devices based on personal preference. In the following sections, the authors attempt to explore the current aesthetics issues of existing medical products and provide some possible suggestions and recommendations for improving these aesthetic elements.

Shape and form

The shape and form of a medical device primarily defines its visual appearance. A study (Nicola Cairns, Murray, Corney, & McFadyen, 2014) attempted to investigate the factors affecting user satisfaction. They found that the most important factor suggested by the users was the shape of the device and how it matched the corresponding part of the body. For prosthetics, shape is an important element related to both functionality and aesthetics. Another study (Sansoni et al., 2015) had similar findings. By exploring the relationship of Uncanny Valley and prosthetic devices. Uncanny valley is a hypothesized relationship between a prosthetic's human-likeliness and individual's emotional response to them. In the study, they selected 30 different designs with three different types of forms – artificial looking devices, devices with moderate human-likeness and devices with high human-likeness. Based on their results, the level of user attractiveness increased in proportion to the human-likeness of the device's form. This demonstrates the importance of designing devices with shapes that resemble or mimic real body parts. Conversely, other studies also suggest that this can generate negative moods instead of feelings of attraction (MacDorman, Green, Ho, & Koch, 2009). Therefore, the impact of shape and form in the design process of ortho-prosthetics should be kept in considerate balance in order to promote user acceptability.

One of the key challenges in achieving an ideal product shape is the packaging and placement of functional elements (i.e., electro-mechanical components). For instance, some battery-powered medical devices, battery placement can be problematic if it is not considered during the design process. These elements can affect product aesthetics and lead to user discomfort.

Pye (1978) suggests that workmanship and the development process also play a major roles in the form of the final product. With 3D scanning technology, it has now become possible to acquire accurate anthropometric data, which can be used to develop accurate digital human models (Shah & Luximon, 2018; Zhuang & Bradtmiller, 2005). It can also be used to develop highly customized medical products. With the continued improvement of 3D printing facilities, it become possible to produce such forms with a high level of precision and superior finishing.

Wearable art is one of the potential future trends in medical product manufacturing Wearables can be customized to fit a particular set of functional requirements and customary aesthetic elements for every user. Existing orthotics and prosthetic devices could then be made to look like wearable art forms that blend with the users clothing. Aesthetics and functions can fused together in this way to give psychological pleasure as well as the feeling of fashion and peculiar style sense. The aesthetics of shape and form may differ based on gender. Previous studies (Oumlil & Erdem, 1997; Weitz, 1998) have demonstrated differences in the choice of prosthetics that were based on gender perceptions.

In designing prosthetics for children, designers should make an attempt to stretch the boundaries of their imagination in order to make products interactive or in the form of wearable toys. Some research groups (Knochel, 2016) have also tried to develop Do It Yourself (DIY) types of prosthetics where the user is given the liberty to design their own device. A South African carpenter who lost his hand due to occupational hazards, sought a customized DIY prosthetic hand. He developed it using online resources and the help of a special

effects artist (Owen, 2011). In addition to individual and laboratory-based applications, DIY prosthetics have also been developed as a manufacturing solution for amputees with the ubiquity and greater availability of more economical 3D printing facilities. The process of DIY ortho-prosthetic design and manufacturing can create new opportunities and facilitate in the design process of medical products.

Size and scale

The size of the product has a substantial impact on visual appearance. Size and material affect the weight of the device. If it is too large, it may cause discomfort and may be inconvenient for daily usage. Minimizing the size and visual prominence of prosthetics is important. Although reducing the size of a device may be more costly and technically challenging, it has a positive impact on patient's psychological well-being. Current braces have metallic parts, which are difficult to conceal under regular clothing. Smart textile materials can be used in place of metallic components to maintain product aesthetics. However, if it is not possible to reduce size or to make a device more compact, then efforts should be allocated to make it unnoticeable and discrete in nature.

The size of a prosthetic should also conform to individual differences in body type to ensure that it maintains perfect symmetry with the contralateral part, side or limb. In order to develop products, which are generalizable and can be scaled according to a broader user base, it is important to understand individual variance in shape amongst the target audience. This can be accomplished by developing a database containing large anthropometric data samples based on country, location, ethnicity, age and gender of end users. Customization techniques like casting; last formation, which have been traditionally used, can be replaced by 3D scanning and modelling to achieve better results. In addition, modularity in ortho-prosthesis can be introduced at a grass root level to optimize device size and fitting. The concept of modular design can be implemented to achieve a "one size fits all" design methodology for mass production and may help to stabilize the user market.

Colour

A lot of research has already been conducted on the relation between colour, user perceptions and product selection (Funk & Ndubisi, 2006; Kauppinen-Räisänen & Luomala, 2010; LoBue & DeLoache, 2011). Although the range of colour options for medical products is limited, still the colour of the product contributes heavily in the product appearance.

In the case of orthotics, there is more flexibility to experiment with different colours compared to prosthetics. Depending on the application and user demands, products can be made transparent or incorporate colour to stimulate concealing. The product design value for users changes when the product style or design parameters also change (Holbrook, Morris B., & Moore, 1981). For instance, traditional dental braces use metallic wiring to correct alignment issues. However, they are not aesthetically pleasing and often make eating difficult for the user. Recently, several dental product manufacturers have started producing transparent dental braces without the slightest compromise on functionality. This example illustrates the influence of colour preference in producing a positive user experience without sacrificing functionality.

With prosthetics, many users prefer the product to be similar to the tone of human skin. Due to the limited amount of colour options for prosthetic devices, matching a user's skin colour is challenging and may influence product acceptance. This could lead to a psychological unacceptance of the product as a part of their own body. Some users prefer their prosthetic devices to be more vibrant and colourful. Several new prosthetic limbs with printed artwork have been made available, which have been well received and successful among young users. Similarly researchers (Lenhart & Sumarriva, 2008) have tried introducing printed cartoon characters on orthotics designed for children which have been very effective. Body art's fashion trends such as tattooing are additional design possibilities whereby prosthetics can be perceived as more of a fashion statement rather than a reflection of personal limitation or disability. An intensive care must be taken to make the colour of the device/product as natural and as iconic to meet the user's acceptability and psychological treat. The user should take certain cultural considerations into account when incorporating this type of device customization as it may not be appropriate for mass production. Interchangeable design skins may be a viable option in such circumstances. It is important to understand user needs and preferences when choosing the colour of ortho-prosthetic devices.

Material and texture

Material selection is a key step in orthotic/prosthetic design. From the perspective of product design, material characteristics have a strong impact on the physical product (De Sausmarez, 1964; Hannah, 2002; Scott, 1951). It is important to ensure the material selected has the necessary mechanical and physical properties required for the functional needs of the user. Concomitantly, careful consideration must be given when addressing more intangible characteristics like perceived values, personal associations and emotions. A study by (Karana, Hekkert, & Kandachar, 2008), provides a detailed summary of key parameters to be considered by designers when selecting materials with a greater emphasis placed on the intangible characteristics of materials for improving the product design process. With advancements in material research and technology, it is possible, with new material options, to satisfy these intangible needs.

In addition, care must be taken to make sure materials should be waterproof so that they can be suitable for various outdoor conditions. Water and sweat could be the potential causes for the invalidation of functional aspects and strongly destroy the aesthetical appraisals of amputee. Excessive sweating may lead to itching, irritation and sores, causing unwanted discomfort to the patient, making it less desirable. The material used should be easy to clean and should not allow colours to fade.

Most medical prosthetic devices use metallic components to provide the necessary mechanical strength and polymers or plastics for the external encasing. Newly developed inert materials such as fiberglass, biopolymers and various metal alloys have been used to improve mechanical strength. The synchronization between user perception and product material should also be considered. Material texture preferences may be influenced by gender and various socio-cultural factors. Material, which mimics skin, may or may not be desirable depending upon the circumstances. More research is needed in this area.

Adaptability to fashion and clothing

Just like physically fit human beings, people with special needs also have the desire to be perceived as attractive. An individual's appearance is highly affected by the style of clothing and fashion accessories being worn. However, the ability to use the prosthetic under fashionable clothing is an aspect often overlooked by medical practitioners when designing the device.

Velcro straps can be used to affix bulky orthotic splints and braces which are often prominent, detract from personal aesthetics and make it difficult to wear clothing over top. Due to bulkiness and prominent visibility of prosthetic devices, the range of clothing is limited Current design technologies have the ability to produce customized and sleek products which can be either hidden under clothes or can blend with an ensemble by matching the contour of an individual physique.

The majority of lower limb prosthetics are designed for wearing normal flat-soled footwear. This reduces the number of footwear options and may negatively alter the biomechanics of the prosthetics predisposing the user to postural imbalance and injury. Hence, there is a need for designing adjustable ankle prosthetics, which not only support body weight but can also adapt to different types of footwear.

Following fashion and style trends are often important for the reasons of personal aesthetic preferences. The aforementioned design considerations would help ortho-prosthetic users have greater autonomy and fewer limitations when it comes to choice of clothing. This could have positive effects on social interactions psychological well-being and self-confidence.

Other factors

Factors like age, gender, cultural affiliations and personal attitude affect consumer aesthetic tastes (Bloch, 1995; Ji, Peng, & Nisbett, 2000; Salkind & Salkind, 1997). Previous studies have shown that males prefer more masculine product patterns whereas females are more inclined towards products of beautiful and elegance (Sansoni et al., 2015). Regulatory and legal factors also affect material selection as products often needs to comply with standards approved by the Food and Drug Association (FDA).

Other factors, which also affect the design process, include the cost of manufacturing and affordability of the target users. However, aesthetics should not be compromised based on manufacturing costs or material selection. Although traditional manufacturing processes help in producing more economical medical prosthetics in mass scale, 3D printing has proven to be highly cost effective concerning the customization of products. 3D printing can also avoid f material waste incurred during the casting and manufacturing process. In

addition, 3D printing techniques can be used to facilitate a modular development of ortho-prosthetic devices for individual customization.

"Toe Talk", prosthetic limbs that make a statement: A case study

Wide range of artificial prosthetic limbs are already available which help users (i.e., amputees) perform various daily activities including walking, jumping and even running. However, the majority of prosthetics limbs currently available are designed without considering aesthetic elements, which may make them undesirable for younger amputees. Hence, an alternate means by which the aesthetics of these prosthetic products can be improved upon without compromising function is needed. This will significantly improve the user experience of young amputees.

In this case study of prosthetic limb socket, a design group explored the opportunities of redesigning a prosthetic limb socket into a modular wearable art, which can give users the liberty to express their uniqueness without hampering the functional aspects of the device.

Design approach – Modular design

Modular designs are based on the concept of separating products into multiple parts, segments or modules that can be individually modified and customized (Duray, Ward, Milligan, & Berry, 2000). Recently, a large number of research contributions have been made in this particular area. A study done in 2014 proposed a similar approach (Seok, Woo, & Lim, 2014), which they termed "Non-finito" product design. The products are intentionally unfinished giving users the option to customize and complete them based on their own personal choices and creativity. This kind of approach can help in achieving mass customization and facilitate product design flexibility based on individual preferences. Allowing users to be actively involved during the design process can help to initiate a better product-user relationship, which would better address the user's needs. This can also make the potential problems encountered in the design phase more visible to the designers.

However, this type of design approach is seldom adopted in the field of medical product design. Therefore, the team attempted to incorporate the concept of a modular design approach without compromising the primary function (i.e., locomotion and movement) of the prosthetic limb.

Design Method

A 25-year-old female amputee agreed to participate in the study. In order to understand her needs, a semi-structured interview was conducted in conjunction with an observational study to define her user profile and understand her daily routine. Based on this study, initial insights about fundamental design needs were acquired. Her input from the interview was considered throughout the design process to ensure the final product (i.e., prosthetic limb socket) did not affect the functionality of the prosthetic limb.

Based on the data gathered from the interviews and observational study, an initial brain storming session was performed. Using the principles of modular design, multiple prototypes were developed using 3D modelling software. Then based on the user preferences, a design was selected and further refined.

For developing the prototype, a 3D scan was acquired for the stump of the amputated limb. Based on the acquired 3D model, a customized prosthetic limb socket was developed using a computer aided designing/ manufacturing (CAD/CAM) software. The final design prototype was then printed.

Design requirements

Being a marathon runner and sports enthusiast in the past, the participant did not want her amputation to affect her self-image. Upon interviewing her, it became evident that she was not happy with a conventional prosthetic leg. She felt it looked ugly and did not allow her to wear fashionable clothes or shoes (i.e., high heels). Instead of hiding her imperfections, she wanted the prosthetic to be a more prominent bodily feature in order to serve as a source of inspiration and encouragement for other amputees. In addition to these design expectations, she also expressed the need for a prosthetic that was easy to wear and store when not in use, the possibility of attaching it with existing prosthetic limb, the ability to reduce sweating with greater ventilation capacity and further modifications to improve durability. Additional factors for consideration included the shape, size, colour, material and manufacturing process.

Design process – prosthetic limb socket

To address her needs, multiple design ideas were generated from the brainstorming session as shown in Figure. 1. The brainstorming session focused on three major criteria: (1) wearable art, (2) mix and match and (3) inner maturity. Several rough sketches and iterations were developed (Figure 2).

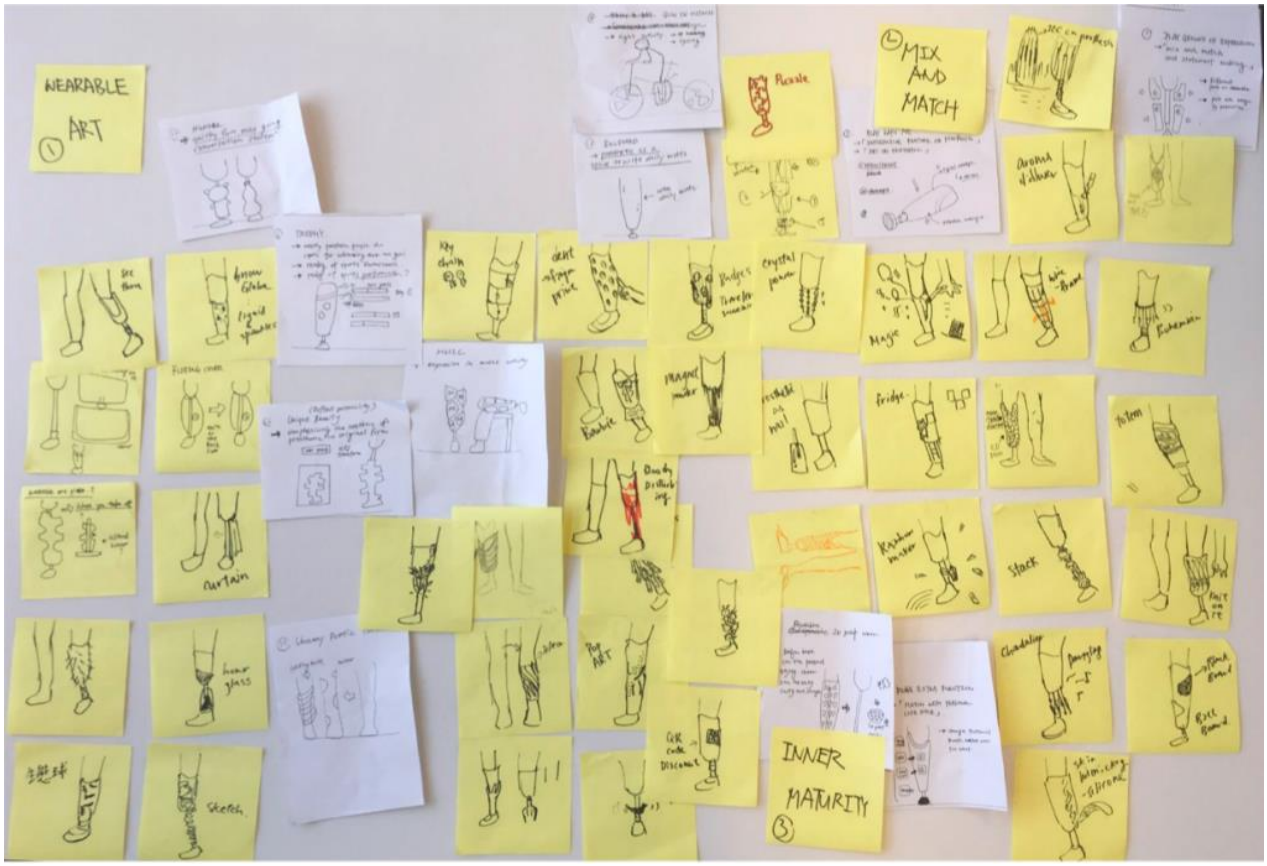

Figure 1: Brainstorming for the design

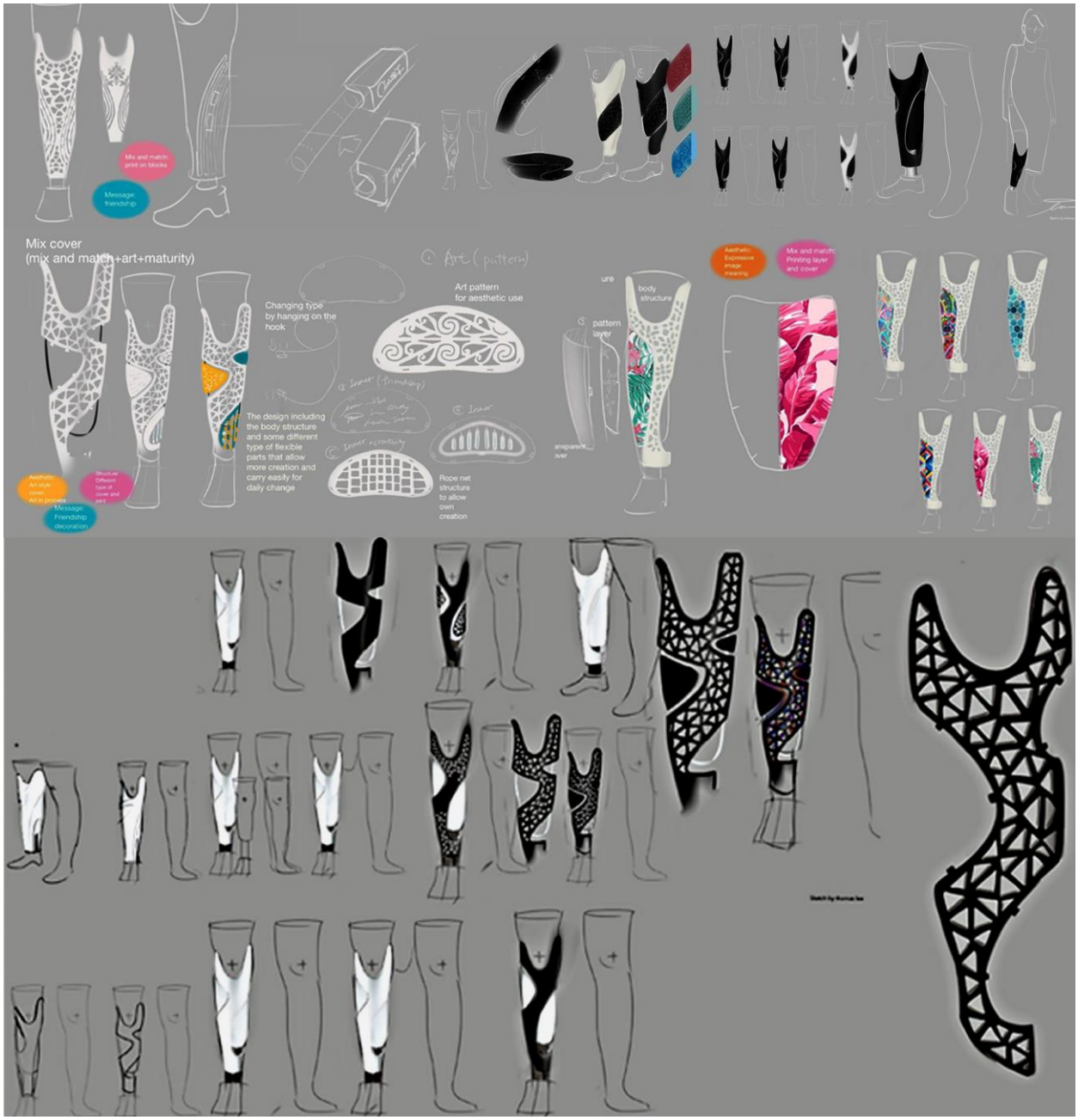

Figure 2: Ideation Process

During the ideation process as shown in Figure 2, initial ideas were further reduced to seven designs based on user preference, choice and needs. Various art and cultural elements were considered during the selection of the opted designs leading to the final design shown in Figure 3.

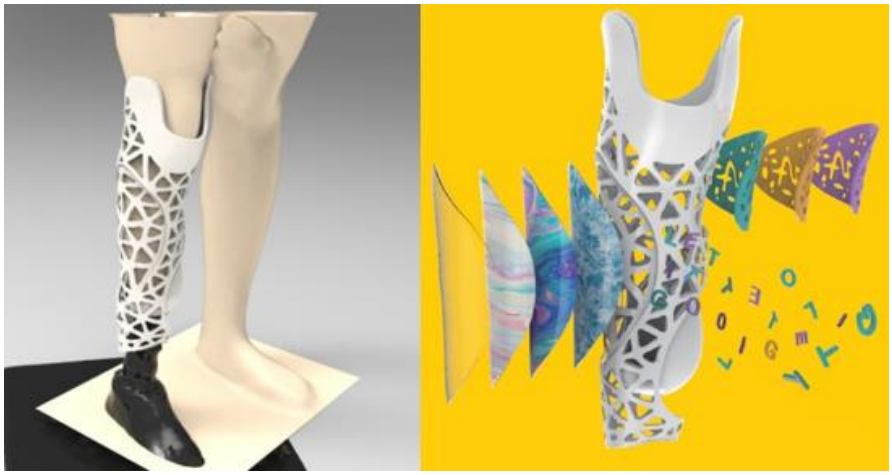

Figure 3: Final design of prosthetic socket

There were three major elements incorporated in the design to make it more appealing and serve as an identity statement for the participant. The first element that was considered was the shape of the socket. It was designed with a mesh form, which made it look more artistic, and at the same time reduced the contact surface thereby allowing it to be more breathable and less prone to accumulate moisture from sweating. Several attachment sites were provided along the device where she could place some text or messages.

The second element of the socket was its use as a wearable form of art. Provisions were made to ensure that certain parts could be removed and replaced. The user can easily slide various images, messages, and photographs in the designated sections of the device based on her mood, clothing combination, life events or the type of event she plans to attend. This provided her with an opportunity to be more creative and allowed her the freedom to use the device as conduit for self-expression.

The third element targeted the issue of using the new design with an existing prosthesis. A two-layered design was created to address this issue. For the existing model, only the outer case design was 3D printed and placed over the existing socket. For developing a new one, the internal frame replaced the socket.

To confirm the shape and size of the newly developed socket matched the contralateral limb, a 3D scan of the existing limb was also acquired to serve as a reference during the entire design process. This was done to ensure limb symmetry and avoid any bulky appearance beneath her clothing thereby allowing her to have a greater range of compatible clothing options.

Based upon her preferences, the prosthetic limb socket was developed in white colour so that it could match any clothing colour. White made it more vibrant, elegant, less likely to absorb heat. In addition, the white background made the other design elements (i.e., attachable text, removable images, and artwork) more prominent.

The final prototype was named "*Toe Talk",* as this gives young, active amputees a chance to express their uniqueness. Unlike traditional prosthetic designs, it is very elegant and artistic.

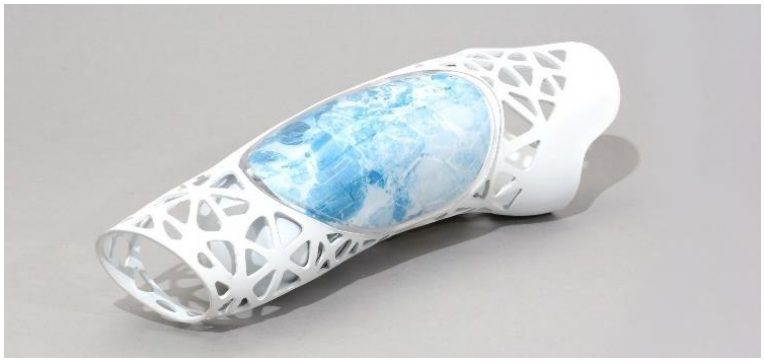

Figure 4: 3D printed prototype – prosthetic limb socket

The designed prosthetic socket was 3D printed and provided to the participant. However, due to structural issues, the design required further refinement. The 3D printed prototype of "Toe Talk" is shown in Figure 4.

Conclusion

Allowing the end user to be more involved in the design process having user-oriented design (UOD) approach can improve upon conventional approaches to ortho-prosthetic device development. With the advent of modular design techniques, it is now possible to develop products, which are partially or entirely customized based on personal preference. Involving the user in the design process has positive psychological benefits and gives the user a platform for highlighting their creativity.

Maslow's hierarchy describes three different levels of user needs. These encompass basic, psychological and self-fulfillment needs. Traditional ortho-prosthetic devices address basic functional needs and allow the user to perform daily activities. Psychological well-being and self-fulfillment needs can also be met by addressing device aesthetics

Ortho-prosthetic product design is a vast and constantly evolving field, which has undergone rapid growth. In past few decades, product designs for amputees have transformed from simple mechanical devices to highly sophisticated bionic devices. However, the aesthetic features of these devices have received little consideration. Studies have shown that the absence of aesthetics can have negative psychological and cognitive consequences for users.

This study attempted to identify some of the key aesthetic parameters, which influence the ortho-prosthetic design process. The authors have provided relevant suggestions and recommendations for addressing these issues with a modular design approach. A case study involving the design of a prosthetic limb socket was given to elucidate the benefits and implications of this user-centered approach.

Developing a single product, which satisfies the needs of every individual user, is challenging. There are social, psychological, economic, cultural and personal preference factors, which influence user perception and experience. Modular and DIY design approaches can help to address these issues by allowing the user to be more actively involved in the design process. With a modular design approach, it is possible to customize prosthetics based on the user's requirements. Users can also employ a DIY design approach by combining different prefabricated parts to manufacture their own product. This could facilitate the customization of such products on a mass scale. Additionally, designing ortho-prosthetic devices in the form of wearable art could revolutionize the field of medical product design and add an element of fashion to the customization process. Not only with this allow the user the option of incorporating their own sense of style or fashion into the development of their device but it can also create awareness for the inclusion of amputees across various social contexts.

For ortho-prosthetic device users, better product aesthetics are more than simply a means of flaunting or showing off, but means by which they can look and feel beautiful or be able to wear fashionable clothing like other people around them. Amputees have the same needs and desires as non-amputees. Meeting their needs is achievable when designers can give the opportunity to reevaluate the ortho-prosthetic' design process with the objective of enhancing user acceptance in mind.

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