



TOOTHBRUSHES FOR UNDERPRIVILEGED CHILDREN: A DESIGN CHALLENGE

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RESUME: Faced with the problem of childhood dental caries and lack of proper brushes for low-income population, we identified the need for an effective product. So this study aims to develop a inexpensive children's toothbrush to be used for children aged from 3 to 5 years. To this end, was conducted an extensive study of users and their aesthetic values, market, materials and manufacturing processes, the functional aspects and guidelines, directing thus the project to a viable solution. The final product enable a low unit cost, because it has a single manufacturing material, it's also ergonomically suitable for defined children.

Key-words: Children's Toothbrush, Product Design, Health.

1. INTRODUCTION

Dental caries is a multifactorial, infectious, transmissible and diet-dependent disease, which produces demineralization of dental structures (LIMA, 2007) and is caused by the accumulation of bacterial plaque on the teeth, which, in turn, is like a mass of color. whitish to yellowish and colonized by bacteria, taking around twenty-four hours to form; its presence is a risk factor for some mouth diseases (RODRIGUES; et al, 2012).

According to the Brazilian Association of Dental Surgeons (ABCD), less than half of children (46.6%) are free from cavities, with the majority of these children concentrated in the South and Southeast states. In Alagoas, specifically, the research revealed that children in the capital, Maceió, at 5 years of age, have a dmft (caries attack index for temporary teeth) equal to 2.71, that is, almost three decayed teeth per child, on average, the highest value among the region's capitals (BRASIL, 2012).

According to Pereira et al. (2014), the most effective methods of controlling plaque include mechanical procedures, such as brushing and flossing daily. The brush is the lowest cost and most clinically effective option for disease prevention.

The age range from 2 to 5 years old belongs to the phase of child development in which children begin to explore and experiment with the motor capabilities of their bodies, seeking to control and improve their movements. For this reason, in this age group the first stage of learning oral hygiene occurs, which, when accompanied by parents and teachers, enables the development of coordinated brushing movements, as their own standards are still restricted or exaggerated (ALBUQUERQUE, n.d.).

Even at this stage, toothbrushes are not chosen and purchased by children but by parents, or provided in schools as a health promotion strategy. There is also a recommendation to change toothbrushes periodically, but the public distribution of the product is not routine and its cost often ends up exceeding the purchasing power of needy families (PEREIRA; et al, 2014).

It is also possible to observe a certain conformity among some communities regarding the lack of oral health care. Furthermore, the issue of childhood tooth decay is worsened by the fact that the so-called “baby” teeth are not permanent and their importance ends up being marginalized. Some families even share the brush among members, which may be a reflection of poor financial conditions or misinformation about the risks of this practice (FIGUEIREDO; FAUSTINO-SILVA; BEZ, 2008).

In the state of Alagoas, brushes that can be accessible to the low-income population still leave a lot to be desired, especially when looking for those intended for children, which creates a lot of damage in relation to the oral health of this portion of the population, as a toothbrush intended for adults does not have the necessary requirements for appropriate use by a child. Likewise, the choice of materials, processes and even the unisex characteristic are factors that can reduce the production cost and consequently the final price of the product.

In view of the above, the need for an appropriate and effective children's toothbrush was identified, as oral diseases are a reality that needs to be controlled and it is necessary to generate this habit from childhood. The project is aimed at a defined target audience, aged between 3 and 5 years old, both male and female, coming from families with low or limited income.

2. METHODOLOGY

The product methodology chosen for the project in question was based on the methodology proposed by Bonsiepe, as it is a flexible methodology, capable of adaptations and a good alternative for project methodology in teaching, as the steps and activities are very detailed.

An extensive analysis of the target audience included, among other bibliographies, the study by Veloso (2008) entitled Segmentation and positioning strategies aimed at the children's market and a practical study related to aesthetic values that included children aged 3 to 5 from public schools Child Development Center (NDI), at the Federal University of Alagoas (UFAL). Next, diachronic analysis, analysis of similarity, structural and functional analysis of the brush, ergonomic and anthropometric analysis, analysis of materials and manufacturing processes and usability analysis, including a case study also carried out at NDI.

Furthermore, the data obtained in the analyzes were crossed with the standards and ordinances available for this type of product, such as Ordinance No. 97/96 which concerns the size of children's toothbrushes (minimum brush length 100mm and maximum head width 12mm), ISO 8627:1987 which concerns the stiffness of the bristles (soft bristles are recommended for children) and NBR 11.786/98 which concerns the safety of toys (use of non-toxic materials, exclusion of sharp corners, small parts that can be ingested or inhaled and from openings where there is a risk of catching fingers), to ensure that the proposed solution will be viable and in accordance with current regulations.





3. RESULTS AND DISCUSSION

The target audience analysis, as well as the field experiment carried out at NDI,

revealed the target audience's preference for saturated and contrasting colors. Therefore, for cultural reasons, the colors chosen for the brushes, seeking to resolve the issue of unisexuality, were orange, yellow and red.

From the detailed study of each system, part and component of the toothbrushes, as well as their possible accessories, it was defined that the children's toothbrush would have a handle, neck, head and bristles. Flat bristles are versatile and can remove plaque and shine teeth, depending on brushing (VICÁRIA, 2010). It was also decided to include the grip (or support), which gives firmness to the grip, and the exclusion of the tongue cleaner, as it is an area that usually comes into contact with bathroom surfaces and the bristle itself can be used for the same purpose. function.

Another point observed refers to the low adequacy of economic products available on the market to aspects of hygiene, safety and especially ergonomics. Table 1 exemplifies the situation with some brushes found in the Maceió market and also in NDI, being used by children.

Brushes	Condor® Toothbrush Adult Free Children 	Dentalclean® Princesses of the Sea 	Kess kids® 	Condor® Trip Brush 
Price	R\$ 1,38	R\$ 5,90	R\$ 4,00	R\$ 1,49
Hygiene	Thermoplastic resin, rounded shape without recesses.	thermoplastic resin and rubber, It has recesses that are difficult to clean.	Plastic material and rubber injection, rounded shape, has recesses.	thermoplastic resin and rubber, It has recesses and a protective cover that is difficult to clean.
Security	Non-toxic material, soft bristles. Head slightly pointed.	Non-toxic material, extra soft bristles with rounded tips.	Non-toxic material, soft bristles with rounded tips and	Non-toxic material, rounded head with medium bristles.

			polished. Head slightly pointed.	
Handle	It has designs with a matte finish. Testing revealed that many children held this brush incorrectly.	It has a rough and rubberized finish. Plus thumb support. Erik's test identified that most children hold this brush correctly (pentadigital grip).	It has a rubberized finish and finger support.	It has a smooth finish. This brush is recommended for adults. When brushing, the child used the brush without the handle.

Table 1. Positive and negative analysis of the brushes found both in the Maceió market and at the NDI public school.

During the visit to NDI, the need for better adaptation to small hands and a format that facilitated correct grip and handling was confirmed. Through carrying out the Erick Test, the brush that had the best result in terms of correct grip (pentadigital) was the Dentalclean® Princesas do Mar, being, therefore, the inspiration for making the handle and grip of the toothbrush in this project.

Considering access to low-income families and the possibility of including the distribution of brushes in social projects, it was decided to use low-cost materials and processes. The injection manufacturing process proved to be the most suitable, as it allows for a large production volume, complex parts with recesses and a very low unit cost. The chosen material is based on the Monobloco® brush, developed by Professor Doctor Pedro Bignelli from the Faculty of Dentistry of Ribeirão Preto at the University of São Paulo, made up of a single plastic material, low-density polyethylene, non-toxic and which, replacing the conventional nylon bristles, has rods separated by narrow spaces and with a market cost approximately five times lower than that of a conventional brush (MACIEL, 2001).

Barros, Pernambuco and Tomita (2001), confirm the choice of this manufacturing process as they state that tests carried out with the Monobloco® brush reveal that the brushes, as they are softer than nylon bristles, promote gum massage, in addition of having greater resistance to the proliferation of microorganisms (as it does not contain amendments) and has a durability similar to that of common brushes (brushes maintain a good cleaning standard even when crooked), taking into account the recommended period of use of three months.

Based on the requirements and parameters, three alternatives were generated, the first emphasizing the ergonomic issue, the second the playful aspect and the third the material savings. Of these, the first is the one that best suits the proposal, as the additional material cost is minimal and ergonomics is one of the most important aspects.

Finally, the technical drawings and rendering of the proposed children's toothbrush were made, figure 1 shows the final solution.



Figure 1. Designed children's toothbrush.

4. FINAL CONSIDERATIONS

Studies have shown that, despite the health need, few products available on the market adapt to the economic needs of this public and those that do have gaps in terms of ergonomic and anthropometric aspects and can be improved.

When developing the project, the importance of methodology and analysis was realized for the structural, formal, functional and aesthetic understanding of the product to be designed. It was possible to note that knowing the user and their aesthetic values in relation to the product, combined with the study of the market, standards, materials and manufacturing processes, is an essential procedure to direct the project towards viable solutions.

The brush generated has non-toxic material and a rounded shape that does not pose a risk to children over 3 years old. The final price of the product, considering the material and manufacturing process, is accessible to the needy population and can also be considered as an option for distributing brushes in social projects. Another great benefit of the brush is its efficiency in children's brushing, massaging the gums, resistance to the proliferation of microorganisms (compared to brushes with nylon bristles) and the ergonomic handle that helps children move around and learn oral hygiene.

It is still necessary to develop the prototype of the brush and carry out several tests, but the initial step of the project, which aims to alleviate the problem of childhood cavities mainly in communities with low purchasing power, has already been taken.

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