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REVIEW

Toothbrushes made and adapted for patients with special needs

Cepillos dentales confeccionados y adaptados para pacientes con necesidades especiales

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ABSTRACT

Introduction: people with special needs often have a high number of caries and periodontal diseases, related to difficulties in ensuring oral health care, access to dental treatment, and sometimes to the socioeconomic context.
Objective: to argue the importance of making adapted toothbrushes for patients with special needs.
Method: a narrative bibliographic review was carried out through scientific articles published in the last ten years, in different digital databases such as: SciELO, Medline, Pubmed, digital libraries, in English and Spanish, using the following descriptors: "disability", "special needs", "oral hygiene", "mechanical and electric toothbrush", "bamboo toothbrush" "partial and/or total assistance".
Development: the effectiveness of tooth brushing depends on the type of toothbrush, its use, the method and time of brushing, the use of mouthwash and/or dental floss. Although there are different methods for preventing plaque formation, the use of toothbrushes has proven to be the most effective way. This group includes patients with moderate or severe physical or mental disabilities and with significant motor limitations in the upper limbs. Many of them remain in wheelchairs or are bedridden for a large part of the time, need help to carry out any oral hygiene procedure and in this sense, with rare exceptions, cannot assume any type of responsibility in the process.
Conclusions: the dentist must perceive the problem of the particular individual and formulate an individual plan, as well as inform the parents and the patient how to carry out such a program. Most patients with disabilities will require the supervision of parents or substitutes to carry it out.

Keywords: Oral Hygiene; Special Needs; Toothbrush; Tooth Brushing.

RESUMEN

Introducción: las personas con necesidades especiales suelen presentar un elevado número de caries y periodontopatías, relacionado con dificultades para garantizar el cuidado de la salud oral, el acceso al tratamiento odontológico, y en ocasiones con el contexto socioeconómico.
Objetivo: argumentar la importancia de la confección de cepillos adaptados para pacientes con necesidades especiales.
Método: se realizó una revisión bibliográfica narrativa a través de artículos científicos publicados en los últimos diez años, en diferentes bases de datos digitales como: *SciELO*, *Medline*, *Pubmed*, bibliotecas digitales, en los idiomas inglés y español, utilizando los siguientes descriptores: "discapacidad", "necesidades especiales", "higiene bucal", "cepillo dental mecánico y eléctrico", "cepillo de bamboo" "asistencia parcial y/o total".
Desarrollo: la eficacia del cepillado de dientes depende del tipo de cepillo, el uso de este, el método y la hora del cepillado, el uso de enjuagues bucales y/o hilo dental. Si bien existen diferentes métodos para la prevención de la formación de placa, el uso de cepillos de dientes ha demostrado ser la forma más eficaz. En este grupo se incluyen pacientes con discapacidad física o psíquica moderada o grave y con una limitación motora importante de las extremidades superiores. Muchos de ellos, permanecen en silla de ruedas o buena parte del tiempo en cama, necesitan ayuda para efectuar cualquier procedimiento de higiene oral y en este sentido, salvo raras excepciones, no podrán asumir ningún tipo de responsabilidad en el proceso.
Conclusiones: el odontólogo debe percibir la problemática del individuo en particular y formular un plan individual, así como transmitir a los padres y al paciente cómo debe llevar a cabo tal programa. La mayoría de los pacientes con discapacidad requerirán de la supervisión de los padres o sustitutos para llevarlo a cabo.

Palabras clave: Higiene Bucal; Necesidades Especiales; Cepillo Dental; Cepillado Dental.

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INTRODUCTION

According to the World Health Organization (WHO), persons with disabilities are those who have physical, mental, intellectual, and/or sensory impairments and, therefore, depend on others to help them carry out daily activities. After a long process of conceptualizing disability, the WHO created the International Classification of Functioning, Disability, and Health (ICF), in which disability is a generic term that includes impairments of body functions and/or structures, limitations in activities, and restrictions in participation. It indicates the negative aspects of the interaction between an individual (with a given health condition) and their contextual factors. All health science professionals now work under the ICF model. A person with a disability is the result of the interaction between their health condition and contextual factors (environmental and personal).[1]

Health is achieving the highest level of physical, mental, and social well-being and functional capacity, which is possible given the social factors in which individuals and communities live. Oral health is integral to overall health, as an individual cannot be considered completely healthy if oral diseases are present.[2,3,4]

Dental conditions are a health problem that affects virtually the entire disabled population. These patients generally have poor oral hygiene, with high levels of bacterial plaque, often exacerbated by a soft diet rich in carbohydrates and refined sugars, which leads to a high prevalence of caries and periodontal disease. This circumstance favors the recurrent oral infections in these patients and their tendency to become chronic. In addition, other stomatological disorders such as irregular eruption patterns, dental malocclusions, oral parafunctions such as bruxism or salivary incontinence, and alterations in the number, morphology, and structure of the teeth are pervasive in patients with specific physical and/or mental disabilities, such as cerebral palsy, congenital polymalformative syndromes, or severe mental retardation.[1,5]

In some severely disabled individuals, harmful factors dependent on the microorganism (number and virulence) and the host itself (previous organic pathology and altered immune response) converge, making them susceptible to focal infections of oral etiology, which, in addition to affecting the cervical-cranial region by contiguity, can compromise the respiratory, cardiovascular, gastrointestinal tract, or other deep structures.[5]

In severely disabled individuals, caries and periodontal disease, in addition to the inherent risk of any infectious process of bacterial etiology (pain, general malaise, risk of septic dissemination), can affect food intake and cause behavioral alterations (aggressiveness, isolation, self-harm), sometimes compromising the patient's nutritional status and their relationship with their environment. The premature loss of natural teeth can perpetuate this situation, as difficulties in swallowing are compounded by those in speech, aesthetic deterioration, and low self-esteem, as well as limitations in accessing rehabilitative treatment.[5]

Dentistry for people with disabilities must be based on knowledge of the foundations or pillars from which to work to generate inclusive care strategies. These are: a) understanding the broad spectrum of disabilities: their etiology and pathogenesis (genetic, congenital, infectious, traumatic; specific disorders or alterations that cause motor, mental, psychological, or sensory disorders), as well as knowledge of systemic diseases and their degree of medical risk; b) working in multi-, inter-, and transdisciplinary teams to take a comprehensive and social approach and personalize the treatment plan; c) knowledge of the specific oral pathology presented by certain diseases, as well as orofacial and functional manifestations, d) knowledge of behavior management techniques to assess the appropriate and personalized care modality, including outpatient sedation procedures and treatment under general anesthesia in indicated cases, e) ongoing training and continuing education.[5]

In general, people with disabilities have a higher prevalence of infectious oral diseases (caries, periodontal disease), either due to causes inherent to the underlying disease or the limitations of the disability (inadequate or absent oral hygiene). In severe neuromuscular disorders, we find malocclusions; in genetic conditions, there is a high incidence of hypocalcification, hypoplasia, amelogenesis imperfecta, and severe oral mucosa lesions. The different complexities of oral disease and orofacial dysfunctions warrant using protocols based on scientific evidence.[6]

Within oral health, teaching oral hygiene techniques is essential. That is why tooth brushing should be the most straightforward method for removing plaque and preventing disease, the most common of which are periodontal disease and caries, the most common causes of tooth loss. As mentioned above, dental plaque is essential in developing these pathologies.[5] Regular and effective oral hygiene, proper diet, and dental check-ups help prevent these diseases. However, people with special needs who have physical, mental, intellectual, and/or sensory impairments find this problematic, and it presents an obstacle to oral hygiene and, therefore, to the prevention of these diseases.[5,7]

Periodontal diseases are chronic, infectious, inflammatory, and multifactorial diseases that are highly prevalent worldwide. They have a wide spectrum of clinical manifestations, ranging from gingivitis to severe forms of periodontitis.[8,9] Chronic gingivitis is induced by dental biofilm and is characterized by marginal gingival inflammation without clinical or radiographic evidence of periodontal attachment loss. It is a reversible condition that can be easily treated and prevented. Periodontitis presents apical migration of the junctional epithelium over the root surface, followed by loss of attachment and resorption of the alveolar bone.

Both caries and periodontitis are caused by an imbalance in the bacterial populations of naturally forming biofilms that help maintain the normal state of the oral cavity. Microbial succession is halted with proper hygiene.[8,10]

Prevention is one of the most important aspects to consider in ensuring good oral health for any patient. An effective preventive program is of great importance for a person with a disability due to social, economic, physical, and medical factors that make good dental care difficult. The dentist must understand the individual's particular problems, formulate an individual plan, and convey to the parents and the patient how to carry out such a program. Most patients with disabilities will require supervision by parents or substitutes to carry it out.[9]

Essential components of a preventive program

Recruitment: part of the program that alerts the parent or guardian about the daily oral hygiene needs of the special patient.

Education: the educational program should emphasize the key points of oral health and its maintenance.

Follow-up: this point is included to monitor the patient's dental health and quality.

Diet is essential in the preventive program and should be evaluated by reviewing a study with the parents; each case will require a diet with independent characteristics. It will be essential to modify the behavior that leads parents to give their children foods such as sweets and candy to avoid possible dissatisfaction and attacks by children with different abilities.[11]

In general, the effectiveness of tooth brushing depends on the type of toothbrush, how it is used, the brushing method, the time of brushing, and the use of mouthwash and/or dental floss. In self-oral hygiene, the primary concern is the removal of biofilm in the interdental areas, such as supragingival and subgingival biofilm. Although there are different methods for preventing plaque formation, toothbrushes have proven to be the most effective.[12]

This group includes patients with severe physical or mental disabilities or with significant motor limitations of the upper extremities. Many of them are permanently in wheelchairs or even spend a considerable amount of time in bed. They require assistance performing oral hygiene procedures and, with rare exceptions, cannot take on any responsibility.[5]

The above details give rise to the objective: to argue the importance of manufacturing adapted toothbrushes for patients with special needs.

METHOD

A narrative literature review was conducted using Google Scholar, searching for scientific articles published in the last ten years in various digital databases such as SciELO, Medline, Pubmed, digital libraries, and university thesis repositories. The following descriptors were used: "disability," "special needs," "oral hygiene," "mechanical and electric toothbrush," "bamboo toothbrush," and "partial and/or total assistance." Articles published in the last ten years, in Spanish or English, and with scientific quality endorsed by results obtained in quantitative studies and systematic reviews were included.

DEVELOPMENT

The following types of toothbrushes are available on the market:

Manual toothbrush

Mechanical devices have been used since ancient times to remove dental plaque—the earliest references to toothbrushes are similar to those used today, dating back to 1600 BC in China. Toothbrushes appeared en masse in the Western world in the first decade of the 20th century after the patent was filed in 1857 in the US.[10]

Toothbrushes must be adapted to individual requirements in size, shape, and appearance and be easy and practical to use. As the main areas where plaque accumulates are the tongue, the cervical third of the tooth, and the gingival sulcus, it is best to use an adaptable brush that does not damage soft tissue. Brushes should not absorb moisture, be easy to clean and store, and be inexpensive as they need to be replaced every 2-3 months due to bacterial colonization and wear and tear. It is advisable after the user has an oral or general illness. The manufacture of toothbrushes must comply with the terms, measurements, and requirements of DIN standards.[13,14,15]

At the European Workshop on Mechanical Plaque Control, the following characteristics of toothbrushes were agreed upon:

- Handle appropriate for age and motor skills.
- Brush head size appropriate for the size of the patient's mouth.
- Rounded nylon or polyester filaments less than 0,009 inches (0,23 mm) in diameter.
- Soft filaments configured according to international industry standards (ISO).
- Bristles designed to improve plaque removal in spaces and along the gum line.
- The bristles (referring to natural animal hair) or filaments (referring to synthetic structure) are inserted into the brush head and grouped in tufts.

Initially, brushes were made of natural bristles (animal hair). Given the shaft's rough surface and the medullary canal's presence, they produced abundant retention sites for debris and foreign deposits. Furthermore, their hygroscopic properties caused them to swell and lose elasticity and consistency, which is why they are no longer used today. Later, brushes were made of synthetic filaments based on Nylon®, a stretched copolymer that varies according to its characteristics in terms of abrasion and recovery of flexibility when dry.

The best material is Tynex®, a Nylon® monofilament containing fine particles for additional abrasion and having the critical characteristic of not absorbing water. According to the conventional classification, these filaments have different resistance gradients: hard (diameter greater than 0,35 mm), medium (diameter of 0,30 mm), or soft (diameter of 0,17 mm).

The tips of the filaments should be rounded to avoid damaging the gingival tissues. Filaments with non-rounded tips can be twice as abrasive and cause 30 % more gum abrasion after 30 seconds of brushing.[10] The filaments are usually inserted perpendicular to the base of the head, although in some designs, they are positioned at an angle to promote interdental hygiene. The plane formed by the finish of all the filaments is usually parallel to the base of their insertion.

However, there are brushes whose filaments at the beginning of the head may be higher than the rest to improve retromolar hygiene. For the same reason, they have been designed oppositely, with those at the beginning lower and those closest to the handle higher. In other cases, all the ends maintain a serrated plane. No conclusive studies indicate more excellent plaque removal in any design per se. The stem is the narrowing that may or may not exist between the head and handle of the brush.

The handle should be appropriate for the age and motor skills of the user and be of sufficient width and length to be handled

safely. They are usually straight or slightly angled to mimic the shape of an intraoral mirror. Currently, there are also handles shaped in such a way that when picked up, the bristles are already angled at 45º.[15]

The bristles can be:

Hard: This is recommended for healthy, well-cared-for mouths with thick gums. The disadvantage is that if too much force is applied, the gums can be damaged.

Medium: mainly used in mouths with good oral health and a very low sensitivity index that can tolerate bristle pressure without any problems. They are still considered too complicated for most patients.

Soft: These are used in more sensitive mouths as they produce less friction; they are currently the most widely used. They are used by people with thin gums and a tendency to control sensitivity.

Extra soft is used on patients with very sensitive teeth and receding gums. It is normal for the teeth to be temporarily sensitive after treatments such as orthodontics or whitening.

Manual toothbrushes according to their purpose:

- Children's: they usually have a smaller head with softer bristles and decorations.
- For removable prostheses: these have up to 4 rows of bristles. They are used outside the mouth.
- Post-operative: these are for brushing areas after surgery or for those with mouth ulcers and/or wounds.
- Orthodontic: these have a shorter central row to better clean braces.
- Interproximal: known as a bottle brush. This interproximal toothbrush removes plaque from the proximal surfaces of the space between the teeth.
- Periodontal: for patients with gum inflammation or a tendency to gum inflammation. Also, for patients with gum recession, we must avoid traumatizing the gums.

Eco-friendly toothbrush

The first eco-friendly toothbrushes are identical to those we know today. They were made entirely from natural materials, meaning they were completely biodegradable and, therefore, environmentally friendly. The handle is the part that has undergone the most changes throughout history. In the beginning, it was made from branches known as "Miswak." which are still used today by some tribes. In 1498, the first toothbrush with a bamboo handle appeared in China. However, by 1930, the eco-friendly toothbrush was discarded with the discovery of nylon, which replaced the animal and vegetable bristles used until then.[16]

Later, eco-friendly handles were replaced by plastic ones, the most commonly used being polyvinyl chloride, better known as PVC. Plastic toothbrushes thus began to dominate the dental industry for approximately two centuries. However, there is now a return to eco-friendly toothbrushes, with the United States being one of the pioneering countries in promoting the resurgence of this type of toothbrush.

The reasons are apparent, the main one being the plastic pollution crisis and its alarming levels, a situation to which the dental industry has unfortunately contributed, and it is clear that none of the toothbrushes produced since 1930 have degraded. It is worth noting that the eco-friendly toothbrush of today initially reappeared with only 100 % biodegradable handles, bamboo being the most commonly used material, while the bristles remained nylon. However, as research progressed, companies such as NaturBrush, Bamboo, Brush with Bamboo, and Ultra have managed to develop bristles made from natural fibers such as bamboo or oils such as castor oil in combination with type 4 or type 11 nylon, which can degrade by 30 % to 80 % under certain circumstances.

Eco-friendly brushes offer multiple benefits in both their design and composition. The bristles are of medium hardness and are certified by the FSC (an organization that protects forests). The bristles are made from a combination of two to three elements:

- Bamboo fibers: a natural fiber with antibacterial properties, which requires only water for its manufacturing process.
- Castor oil: a product obtained from the seeds of the shrub Ricinus communis, which has biodegradable properties and is currently the most hygienic option. Bichotan or activated carbon: a type of charcoal made from wood of Japanese origin, recognized for its high quality and properties as a whitener, detoxifier, and purifier.
- Minimal amount of Nylon type 4 and 6 (10 %): polymers with good resistance to oils, fats, and solvents but not to ozone, ultraviolet rays, and humidity, which cause them to degrade. In addition, this type of nylon is free of BPA, a compound used in manufacturing plastic that has negative health consequences.

The handle is made from bamboo, belonging to the Phyllostachys edulis (MOSO) variety. This plant grows quickly and naturally in the ground and is characterized by its antibacterial agents, rapid renewal capacity, and high resistance.

It is 100 % biodegradable and decomposes thanks to the action of biological agents such as plants, animals, fungi, or microorganisms under natural environmental conditions in approximately 60 days, achieving total degradation within a year.[17]

Electric toothbrush

With the advancement of miniaturization of electrical appliances, Bergman and Woog invented the first electric toothbrush in 1952, but it was not marketed until 1960 under the name Broxodent. This toothbrush performs wide oscillating movements (18 to 23 mm) at 40 to 70 Hz. As a result, it eliminated manual fatigue, but to achieve brushing as effectively as with a manual toothbrush, it was necessary to increase brushing time.[17]

What made it a technological "gadget" rather than a proper oral hygiene tool? Technologies continued to evolve, and other systems were invented to improve plaque removal.

Today, existing self-powered systems can be classified into two prominent families:

Rotary systems with rotary brushing, oscillating-rotary (2D technology) and pulsating oscillating-rotary brushing (3D technology).

Sonic motion systems

The effectiveness of toothbrushes varies considerably from one model to another, given the wide variety available to patients, who often struggle to find the most suitable toothbrush for good oral hygiene.[15,18]

Furthermore, in the case of training, the use of an electronic toothbrush only promotes brushing movements due to increased awareness of movements and attention to performance due to the provision of electrical stimulation. Therefore, it is limited to learning detailed movements and postures and improving the accuracy of tooth-brushing movements. Consequently, even when training with an electronic toothbrush, additional education and training processes are required to learn the appropriate movement and form the correct toothbrushing pattern.

Despite all the toothbrushes available on the market and the diversity of models, patients with different abilities encounter problems with their dental hygiene, as using a toothbrush requires brushing techniques, a certain amount of time, fine motor skills, and partial and/or total assistance.

Partial assistance

This includes people with moderate to severe mental disabilities or significant motor limitations. Generally, these patients cannot brush their teeth effectively, and those who try, at best, manage to remove plaque from the buccal surfaces of the anterior teeth.

They require close supervision and direct assistance to brush correctly; the same is true for other daily tasks and to meet their basic needs. The training period is long, and results are often poor. It is essential to be aware of these patients' limitations and positively reinforce small progress.[19]

Total assistance

Triple-headed toothbrushes are available in some countries, and some heads with special shapes have been marketed to facilitate more excellent removal of bacterial plaque in less time. For example, the bristles of the Collis-Curve® (Canada) and Dr. Barman's Superbrush® (Spain) toothbrushes simultaneously clean the teeth' occlusal, lingual, and vestibular surfaces. Both are particularly suitable for people with learning difficulties when caregivers have problems accessing and cleaning tooth surfaces with a conventional toothbrush and for people with physical disabilities, either due to limited hand movement or because they tire quickly, as is the case with patients with multiple sclerosis or Parkinson's disease.[19]

They can be purchased on platforms such as Amazon, Alibaba, and Mercado Libre in Colombia, Chile, and China. In Argentina, triple-headed toothbrushes are not easily accessible and are difficult to purchase due to cost, logistics, and website management. They are not available in pharmacies or supermarkets, making them accessible to only a few.[17]

In Argentina, official data on disability correspond to the last national census, conducted in 2010. The National Institute of Statistics and Censuses (INDEC) published the preliminary results of the National Study on the Profile of Persons with Disabilities (2018), showing that 12,9 % of the Argentine population has some disability. Although there was a new census in 2022, this group of people was not counted. There are no current data on them.[18]

This is why the authors decided to design a toothbrush for people with different abilities that is accessible and can be made by a dentist and/or caregiver. Caregivers can also consult their dentist if they do not have the necessary materials. Technological advances could make it with a 3D printer, or this idea could lead to better ideas. To do this, it is essential to:

1. Use three identical plastic toothbrushes with small heads. (GUM 311 toothbrushes were used.)
2. Cut the head off two brushes, leaving a margin at the bottom for later attachment.
3. Smooth the cut edges with a bur or sandpaper.
4. Cut the inner row of bristles from the two heads without handles using scissors.
5. Cut the bristles on the center brush to reduce their length.
6. Prepare the side surfaces of the cut brushes that will be joined to the central brush with the handle. Wear down the right edge of the head on the left side, making an angle of approximately 20° with an inverted cone or conical stone, creating a roughness to promote retention and bonding to the central brush.
7. Repeat the same procedure with the head to be joined to the right side.
8. Prepare the outer edges of the base of the central brush by wearing down the side edges with a milling cutter or sandpaper. These will then be joined to the heads modified in steps 5 and 6.
9. Prepare enough acrylic (powder and liquid) to join the three heads.
10. Place the acrylic on the worn edges and press down until it sets. Repeat on both sides.
11. Reinforce the joint between the three heads and the handle with acrylic and wait for it to set.
12. Polish the rough parts with high-gloss polishing paste.

The brush has three heads that allow the tooth surfaces to be cleaned simultaneously, making brushing easier for the caregiver. This reduces the time spent brushing, one of the most beneficial factors, as many people with different abilities do not understand and tire quickly.

With proper planning, clear communication, and carefully defined limits for the service provided, the dramatic dental neglect experienced by most individuals can be successfully alleviated. Despite the high level of dental disease, people with disabilities

or illnesses receive less oral care than the general population, and dental treatment has been reported to be the most significant unmet health need of people with disabilities. The most important reasons may be inadequate health systems, practical difficulties during treatment sessions, socioeconomic status and underestimation of treatment needs or pain, communication problems, and poor cooperation.[19]

CONCLUSIONS

People with disabilities are entitled to the same standards of health and care as the general population. Still, there is evidence that they experience poorer overall and oral health, have unmet health needs, and lower acceptance of screening services. The oral health of people with disabilities may be neglected due to their disability, a demanding illness, or limited access to oral health care. They present specific challenges when assessing their oral health.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

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