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Oral Cancer Biomarkers: Is it a Meaningless Game?

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KEYWORDS: FOXM1; Exosomes; Salivary biomarker; Extracellular vesicles; Non-invasive diagnosis; Oral cancer; Saliva; Big data; Omics; Translational research; Clinical translation.

There are forever new biomarkers discovered every now and then, claiming for their clinical diagnostic and prognostic potentials. When is it going to end or would it ever ends at all? During the pre-omics era, it used to be only a handful of protein markers with well-studied in-depth mechanism of actions. Then came an explosive big data era: genomics, transcriptomics, proteomics, epigenomics, metabolomics, etc., generating huge amount of biomolecular data beyond researchers' ability to handle let alone understand their significance in health and disease.^{1,2} It was akin to a child walking into a candy shop overwhelmed by the choices. Researchers are currently busy trying to make sense of these data and slowly attempting to translate them into clinical benefits.² Just within the field of oral cancer, omics data are being generated from all sorts of host samples types, including saliva, buccal swaps, tissue biopsies, serum, plasma, lymphatic fluids, etc. Within each sample type, one has choices of investigating Deoxyribonucleic acid (DNA), Ribonucleic acid (RNA), protein, metabolites, small molecules, etc, originating from various cellular compartments such as nuclei, cytoplasm, membranes, mitochondria, microvesicles (exosomes),³ extracellular fluids (serum, plasma, lymphatic fluids, etc) and etc. Disease and healthy samples are being compared in the aim to identify key driver 'cancer biomarkers' with clinical potentials. As cancer is now perceived as a disease due to 'molecular reprogramming',⁴ hence, biomarker researchers are trying to identify global molecular events that induce normal cell to reprogram itself into cancer. Given the complexity and heterogeneity of cancers, predictably, huge numbers of molecular differences exist between normal and cancer samples, and can vary from individual to individual.

There is another dimension of added complexity in the oral compartment the microbiome and its interaction with the host. There have been reports showing microbiome signatures could be used as cancer biomarkers,⁵ generating even more potential cancer biomarkers (probably surrogate) based on microbial-host interactions. Recently, human host cell secreted extracellular vesicles (including microvesicles and exomes) have been found to carry potential surrogate cancer biomarkers either on the membranes or within the vesicles to modulate tumor micro-environments^{3,6,7} or seeding fertile ground for primary tumor cells to establish organ-specific distant metastasis.⁸⁻¹¹

Whilst system biology (the 'omics') are slowly unravelling the complex biology of cancer, new and supposedly better biomarkers/drug targets (each claiming to be representing a major oncogenic mechanism) than previous ones, are emerging daily, thus, painting a rosy picture of victory against cancer in the near future. Does this mean that all previously discovered biomarkers are suddenly being rendered obsolete? Are we now better at diagnosing oral cancers as a result of all these novel research? The key question is: Are we translating these fantastic discoveries into clinical use? Unfortunately, a short answer is not (yet)! Big data research is expensive therefore there is a bottleneck in translating big data into cost-effective clinical benefits.²

The evidence for the lack of improvements in oral cancer burden is indisputable. Global disease burden for many cancer types are decreasing,¹² unfortunately, head and neck cancer includ-

ing oral cancer incidence and death rates are increasing especially in females and in developing countries.¹³⁻¹⁵ A worldwide consensus opinion appears to be that of inability to identify and treat early malignancy that resulting in no improvement in survival rates over the last 3 decades.¹⁶⁻¹⁸ In China, evidence gathered from oral cancer incidence between rural and urban areas¹⁹ indicated that there was no improvement in urban survival rates despite increased detection rates. This could be due to the lack of effective diagnostic test that could identify high-risk patients at early stages when treatment is most effective. Such data is neither surprising nor exclusive to China.¹⁵ The 5-yr survival for early localised oral cancer can exceed 80% but falls to less than 20% in late stage tumors that involve regional lymph nodes.²⁰ It is well documented that improved diagnostic and prognostic accuracy to inform the most appropriate intervention could significantly improve patient outcome, reduce mortality and alleviate healthcare costs.²¹ Hence, clinicians desperately need a cost-effective, practical, objective method for diagnosing and quantifying patients' risks²²⁻²⁴ for early oral malignancy so that patients could be treated at early stages of the disease when it is most effective. Research strategies and science funding should be focusing on encouraging the translation of the large number of new biomarkers emerged from big data research into cost-effective practical clinical tools to benefit patients. Efforts should be geared towards setting up infrastructures (e.g., clinical bio-bank, clinical databases, etc.) for enabling translational research linking basic scientists to clinicians who have excess to patients. It would certainly be meaningless to discover huge numbers of new potential cancer biomarkers but not translating them into clinical use.

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To Mill or Not to Mill: The Pluses and Minuses of CEREC in the Office

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With digital dentistry making huge strides and becoming an everyday part of our field, it is very tempting to try out the new technology to improve and hone our current clinical skills. Every office has something digital, whether an apex locator for every endodontic root canal procedure or digital radiography and being able to blow up an intraoral image to the size of a monitor screen for diagnostic reasons, dentistry of the past is just something that would hinder our practice today.

It is due to this logic and the introduction of the Zirconium CEREC milling that our office took the plunge and purchased the new CEREC 4-motor unit and Omicam that is capable of milling Zirconium crowns and the Speed fire oven that is able to Sinter these milled crowns and give them the strength of up to 900 MPAs after heating them to almost 3000 °F. The other material that the Speed fire is able to use is the Duo blocks by Dens plies, a Zirconium reinforced lithium disilicates.

The digital impressions are truly amazing. The omnicam shoots a video so nothing is missed, and you instantly know if anything was not fully captured. It is great not to have to use impression material, or “Guue,” as my patients call it and have to wait for 5 min for it to set, watching the patient fight back gagging. It is also an incredible help to be able to check the impression with the patient chair side and rescan any areas you would want more detail of at huge magnification.

Another amazing component is the ability to magnify the impression on the CEREC omnicam captureunit screen to 300 times the size of the anatomical tooth to read the impression margin. As much as I love my lab, they just can't magnify the impression pour to anywhere near the same size that I can digitally. This type of detailed work all done chairside really lets the dentist come incredibly close to the actual margin and sealing the tooth and crown junction on every level. The depth of field of the omnicam is 14 mm so it is able to get every part of the topography that a prep may have, The digital impression alone from any manufacturer is very detailed and incredibly accurate, but there are definitely the possibility of some of the same pitfalls if the lab has to mill out a model and then work on it rather than a chairside crown milling. This again re-introduces the human error aspect to the crown making process as opposed to the machine taking it from start to finish.

However the CEREC Omnicam also comes with a milling unit. For the measly price of \$165,000 what else would one expect. The mill is able to generate a crown right there and in the same appointment. You can glaze the final product and deliver it to the patient all in the same 2-hour period and there is no need to temporize the tooth.

The advantages to not having a temporary are staggering. Sure the fact that there are no interim recementing appointments if a patient chooses to violate their dietary restrictions is a big plus, but what actually happens to a tooth in a temporary is something some never consider. The temps by nature start to leak immediately and irritation of the periodontia is quite severe. After the 2 weeks of post-op time the gum is usually irritated and requires extra precautions when the final permanent cementing is seated and cemented. There is more irritation to the

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nerve and the weak dentin is exposed to much more bacteria than it was before the crown was prepped, since temporary cements such as TempBond leak profusely.

The mill is able to avoid all these pitfalls by fabricating a final permanent crown chair side. The crowns margins are perfect, or as perfect as the provider selected them to be, and the ability to set these margins exactly takes the ultimate control of the restoration and puts it in the dentist's hands. The patient may also be numb from the initial crown preparation itself so we are able to deliver the crowns using the amazing enamel and dentin bonding techniques on the market today and the patient will have no sensitivity as they are still usually profoundly numb on the mandible, and may require just a light touch up of anesthesia on the maxilla. The crowns also rarely need adjustment from all aspects including the occlusion, which is almost always perfect and same on the interproximal contacts.

So why would we all not be rushing out to get a CEREC in our office today? What is keeping the rest of dentistry away from the Zirconium product released by Sirona CEREC this past spring of 2016? It couldn't just be the learning curve!

For me there are still a few concerns that I can't leave at the door in exchange for the perfect marginal fit, and they are certainly ones each and every dentist should know about and consider. First, even with as much time as the CEREC machine saves, it still requires 2-hour appointments where the dental chair is in use for the entire duration. I am not too keen on sending a toothless patient into the waiting room. The usual crowns with the temporary in place would normally take half that time amount. At this point some would obviously recognize that there is no need for the following 2-week insert appointment, and that is certainly true. However, the insert usually takes about 30 min, so time is still lost in this average equation (However as we all know, there are times and patients that require more adjustment than most, and in those times, the CEREC machine is a dream). And to be honest, if time was the only factor, I can easily look past it, if I was delivering a better service to the patient.

The other and more serious issue I currently have with the CEREC Zirconium milling system is that the colors are just not as good as ones made in conventional dental labs. Zirconium blocks look very monochromatic and way too light when the crowns are milled and sintered. The durability and strengths are there in the Zirconium product, but the tooth shades are just not to par. This is somewhat remedied with the Duo product but only at a fracture of the strength. Duo blocks allow for 180 mPas right out of the mill and after glazing in the Speedfire oven the strength does increase but to about 380 mPas which is far short of the 900 mPas granted by the Zirconium product. But when I say somewhat, that's exactly what I mean, The colors are nowhere near as dynamic as the ones on the Vita Shade Guide, and the 3-D shade Guide shades are just not possible using the CEREC system. If you contact Sirona, they will inform you that you can always use the Vita and Emax blocks that have been around for ages now, and that they are much prettier than the Zirconium strengthened products. But that drops your strength to 120-150 mPas maximum and that is not a corner I would want to cut when it comes to teeth. After all, tooth strength is something that is maybe even more important than shades to a large faceted of the population.

This truly leaves me at a loss. I do not have the answer to this dilemma I am currently in, so I figured I'd share it with you. I value the strength and beauty of my dentistry since I am in an esthetically driven cosmetic office, but that's not to say that my patients do not value long-term function, so I want my \$165,000 mill to be able to give me both. My hopes are that this is just the beginning of the Zirconium revolution in the world of crown milling and that Sirona, the makers of CEREC will have more options for the cosmetic dentist who is concerned with strength as well. My trial 4 month period is almost over and I have milled over 150 crowns using the CEREC machine, but my lab is still very much an everyday part of my office for all anterior crowns and same is true for some premolars and molars. Dentistry is an art and a science, and I need both mastered from whomever is making my crowns.

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The Smile Solution: Smile! How to Make Yours Perfect

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An esthetically pleasing smile is an attractive quality that lures people to you, making them immediately respond positively to a first impression, before you've uttered a single word. The great news is that perfect smiles are no longer limited to Hollywood celebrities (more on that in a minute). With today's technological advancements and software, everyone can achieve the bright-white, glistening smile of their dreams.

What constitutes the perfect smile?

If we study the beauty of nature, art—or teeth—we will discover a common principle running throughout. This common principle is none other than the Golden Proportion, a phenomenon related to beauty. The Golden Ratio (or “Golden Section”) is based on Fibonacci Numbers, where every number in the sequence (after the second) is the sum of the previous 2 numbers:

1, 1, 2, 3, 5, 8, 13, 21, ...

If you read the bestseller, *The DaVinci Code*, you'll certainly be aware of The Fibonacci Numbers; they lead to the Golden Ratio of 1 to 0.618. It all has to do with beauty and ratios of proportion, and as a dentist, I can use dentistry, both an art and a science which relies on this mathematical principle to make sure that all of your teeth are in proportion to your face, to your lips and to each other. In just one example, without being too technical, the width of your upper central incisor should be in the Golden Proportion to the width of the lateral incisor.

Or, in another example, in an ideal smile line, the edges of your upper teeth should be parallel to your lower lip when you smile. Furthermore, both sets of teeth should look similar and complement your hair, skin and eye color.

The starting point of any smile makeover is the facial midline, an imaginary vertical line drawn between the front 2 upper teeth. For optimal esthetic value, the facial midline should be in the middle of the face. I find it really interesting that, when I look at a photograph of actor Tom Cruise, his midline is way off, as he is missing an upper left lateral tooth on the left side of his mouth. Whenever possible, the midline between the upper front teeth (central incisors) should always coincide with the facial midline and Tom's do not.

Brad Pitt (who lately doesn't have any reason to smile) always smiles with his upper teeth, as he has crowding on his lower teeth. You'll never see him smile with his lower teeth. Google his picture and that's what you'll always find. His smile is a definite award-winner.

Actress Julia Roberts has been banking on her smile for a long time. She has teeth of equal length, color, symmetry and balance. She has what I call “pretty teeth”, in that her teeth are feminine, with rounded edges.

Actor Denzel Washington has a great smile with teeth that are more square at the incisal edges, and his face is one of the most symmetrical in the world.

Are you seeking a smile makeover?

The principles of smile design are divided into 4 parts:

Facial Esthetics: They include how the lips frame your smile when you speak, smile or laugh.

Gingival (Gum) Esthetics: The health and appearance of your gums are essential elements in smile design. Excessive gingival display (having a gummy smile), uneven gum contours, inflammation and exposed root surfaces are common gingival-based esthetic complaints that detract from your smile's appeal.

Microesthetics: This involves the subtle characteristics that make your teeth look the way they do, such as how they reflect light and unique marks or colorations. The ideal restoration is one with qualities closely resembling those of natural teeth.

Macroesthetics: This analyzes the relationships and proportions between front teeth, surrounding tissue landmarks and facial characteristics, in order to ensure natural and attractive restorative care and smile makeover treatment.

DISCLOSURE

This dental article is not intended to defame the mentioned actors/actresses in the above piece and it is presented solely for the purpose of education using broadly known and recognizable faces. We thank the people mentioned for contributing to our study of dental esthetics.

Case Report

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Congenitally Missing Mandibular Second Premolars: A Case Report

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ABSTRACT

Congenitally missing teeth are a common developmental abnormality. It is defined as the developmental absence of teeth excluding the third molars. It is more commonly seen in permanent dentition but rarely in primary dentition. Second premolars are the most commonly missing teeth after the third molars. This paper reports a case of non-syndromic bilaterally congenitally missing second premolars in the mandibular region and its management.

KEYWORDS: Congenitally missing teeth; Mandibular region; Second premolars.

INTRODUCTION

Developmental alterations in the number of teeth that develop are common. Hypodontia denotes the lack of development of one or more teeth, oligodontia refers to six or more missing teeth, and anodontia to the complete absence of teeth. Hypodontia is common in permanent dentition as compared to primary dentition. According to Graber, the overall frequency of patients with congenitally missing teeth excluding the third molars has ranged from 1.6-9.6% in various studies in different countries.¹ Although any of the 32 permanent teeth may be missing but those most frequently missing in children are the mandibular second premolars, maxillary lateral incisors, and maxillary second premolars as confirmed in studies by Glenn² and Grahnen.³ Females are more often affected as compared to males with a predominance of 1.4:1.⁴ There is a close correlation between congenitally missing deciduous teeth and their permanent successors according to the study of Grahnen and Granath.³

Multifactorial etiology combining genetics, epigenetic and environmental factors has been suggested by Al Shahrani et al and Larmour et al.^{5,6} Regulatory homeobox genes found to be associated with tooth agenesis consist of MSX-1, PAX-9, EDA and AXIN-2.⁷ It may also be associated with some environmental insult during development. The presence of hypodontia may be associated with other dental anomalies such as small and short crowns and roots of the teeth that are present, conical crown shape, enamel hypoplasia, taurodontism, delayed eruption, prolonged eruption of primary teeth, infraocclusion of primary teeth, ectopic eruption, transposition, lack of alveolar bone, reduced vertical dimensions, increased overbite, and tooth impaction.⁸

A multidisciplinary approach may be indicated in the clinical management of problems associated with missing teeth.

The aim of the present article is to present a rare case report of congenitally missing bilateral mandibular second premolars in an adolescent patient and describe its management.

CASE REPORT

A twelve-year-old male reported to the Department of Pedodontics and Preventive Dentistry with the chief complaint of pain and discomfort in the lower left teeth region. Thorough intra-

oral examination showed presence of grossly carious mandibular primary first and second molar. The family and medical history of the child patient regarding missing teeth was insignificant (Figure 1). The other teeth were of normal color, size and shape. Intraoral periapical radiograph further revealed the absence of tooth buds of 35 and 45. Panoramic radiograph (OPG) revealed the absence of mandibular right and left second premolars along with absence of tooth buds of 18, 28, 38 and 48. (Figure 2)



Figure 1: Intraoral photograph showing retained deciduous mandibular left second molar and missing right second molar.



Figure 2: Panoramic view of bilateral agenesis of mandibular second premolars.

The mandibular second premolars were missing, thereby confirming that it was a case of congenitally missing teeth. The parents of the child patient gave no history of extraction, dental anomalies and consanguineous marriage. A thorough general examination was carried out to rule out the presence of any associated syndrome.

DISCUSSION

True anodontia or congenital absence of teeth can be found in almost any region of the dental arch and in both primary and permanent dentitions. According to the most accepted theory hypodontia is multifactorial and results from a combination of genetics and environmental influences.¹ True anodontia or congenital absence of teeth can be classified into two types, total and partial. Many cases of congenitally missing teeth have been reported in the literature, but this case report presents a unique case of management of bilaterally missing second premolars in the mandibular region without extraction.

Missing teeth are associated with trauma, infection,

radiation, chemotherapeutic medications, endocrine disturbances, and severe intrauterine disturbances.¹ Somatic diseases like syphilis, rickets and scarlet fever have also been associated with tooth agenesis.⁷ Tooth agenesis has been associated with a lot of syndromes and dental anomalies like orofacial clefts, Downs syndrome (trisomy 21), Book syndrome, Coffin-Lowry syndrome, Goldenhar syndrome, Ellis-van Creveld syndrome, Marshall-White syndrome, Johanson-Blizzard syndrome, Gorlin-Chaudhary-Moss syndrome, Progeria, Tooth-and-Nail syndrome, Witkop syndrome.^{1,7,8}

Recently it has been reported that tooth agenesis in humans is caused by mutations in gene encoding low-density lipoprotein receptor-related protein (LRP6).⁹

Hypodontia may lead to abnormal spacing of teeth, delayed tooth formation and deciduous tooth exfoliation, late permanent tooth eruption and altered dimension of the associated gnathic regions.⁸ Tooth agenesis can result in dental malpositioning, periodontal damage, and lack of development of maxillary and mandibular bone height.¹⁰

The treatment of congenitally missing mandibular premolars pose a challenge for the pediatric dentist as lot of therapeutic options are available with their innate advantages and disadvantages. Selection of the right treatment plan is of utmost importance for long term aesthetic results. Therapeutic options most commonly used to resolve the problem include either extraction of second deciduous molar or retention of the deciduous molar. Extraction of deciduous second molars can be planned if second premolars are missing due to pulpal pathology, crowding in permanent dentition, ankylosis and differences in tooth sizes between deciduous and permanent teeth.¹¹ However if crowding of teeth is associated with bilaterally congenitally missing second mandibular premolars, then the case can be managed with a multi-specialty approach in which deciduous second molars are sectioned, prepared for full coverage crown followed by correction with fixed orthodontics.¹² Hemisection or controlled slicing technique can also be used which is based on slicing the second primary molar and removing the mesial half allowing the mesial drift of the first permanent molar with less anterior tipping and loss of anchorage.¹³ Hemisection technique not only preserves the buccolingual ridge but also prevents the formation of a lateral buccal bony depression.¹⁴ It was also noted that late decisions on extraction or hemisection of second deciduous molars increased the likelihood of average to poor results.^{14,15}

A multidisciplinary approach can also be used to ensure functional occlusion and aesthetics at the same time. Genetic counselling may play an imperative role in children with multiple missing teeth.

In the present case the left deciduous second molar was retained and since the right deciduous molar was already extracted, the first permanent molar was allowed to drift mesially.

The child patient was kept under follow-up to observe the pattern of eruption of teeth.

CONCLUSION

Congenitally missing teeth is a dental anomaly with multifactorial etiology, occurring with greater frequency in females and in the permanent dentition. It can occur in both the maxilla and the mandible.

Retaining a deciduous mandibular second molar can be a viable treatment option in cases where anterior crowding is not present. As very few studies have been done regarding the risk factors and severity of congenitally missing teeth, future studies are recommended.

CONSENT

The patient has provided written permission for publication of the case details.

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Impact of Oral Health in the Elderly Patients Quality of Life

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ABSTRACT

Aim: Oral health can affect the quality of life (QoL), and the oral health impact profile-14 (OHIP-14) index utility to assess this impact.

Objective: To study the impact of oral health on quality of life of patients older than 50 years, verifying, preliminarily, the reliability of the OHIP-14 index.

Methods: We studied the internal consistency of the index by applying the alpha-Cronbach coefficient. The OHIP-14 index was obtained by the additive method, and the patients were divided according to gender, age and education level.

Results: Considering all the issues that make up the OHIP-14 index, good internal consistency was obtained. The homogeneity of the questions in the index, it was confirmed that condition, since the difference between the value of the total Cronbach's alpha-factor and issues was less than 0.03. The values of the intraclass correlation show the stability of their items.

Conclusion: The OHIP-14 index was consistent and proved to be there relatively high impact of oral health on QoL of patients, with a predominance of physical pain in its components "feel bothered to feed" and "feel pain in the mouth" as well as the components of the psychological impairment.

KEYWORDS: OHIP-14; Physical pain; Psychological disability; High impact.

ABBREVIATIONS: QoL: Quality of Life; OHIP-14: Oral Health Impact Profile-14; WHO: World Health Organization; REC: Research Ethics Committee.

INTRODUCTION

Over the last few decades, there have been several changes in the political, social and economic scenarios in Brazil. The health of the elderly is increasingly awakening the interest of researchers, since aging of the population is now a reality both in developed and developing countries. Oral health is among the factors that can exert influence on the QoL of the elderly people, since poor oral health conditions result in difficulty in chewing, speaking, or even in the relationships with other people.¹⁻³

The concept of QoL is related to self-esteem and personal well-being and covers aspects such as socio-economic status, lifestyle, cultural, ethnic and religious values, health, family support, self-care, intellectual, social interaction, emotional state, job satisfaction and activities of daily life and the environment in which we live. Thus, the concept of QoL is subjective and depends on socio-economic status, age, and desires of each individual.³⁻⁵

Measuring QoL is very subjective, because it is inherent to the individual, related to their more personal characteristics, both in aspects of hereditary nature as those stuck for life.³⁻⁵ There are two ways to measure quality of life: generic tools and specific instruments. The con-

cept of oral health-related quality of life describes the impact of oral facial conditions and effect of dental interventions. It is a broad and comprehensive concept which is widely influenced by physical health, psychological state, social relationship and environment.²⁻⁵

Among the instruments that assess the impact of oral health conditions on QoL of individuals, there is the oral health impact profile (OHIP).⁶⁻¹¹ OHIP-14 is a subjective indicator and the most widely used to assess the impact caused by oral conditions and QoL.^{9,11} Considering that oral health might have a negative impact on the QoL, the aim of this study is to evaluate the influence of oral health conditions on QoL elderly patients.

MATERIALS AND METHODS

It is cross-sectional study, conducted by personal interview, applying the Brazilian version of OHIP-14 (Table 1). They interviewed patients older than 50 years who required routine care at the Faculdades Unidas do Norte de Minas (FUNORTE), MG 39404-549, Brazil. The survey was conducted in the first half of 2016 and turned to the problems that the patient would have presented the six months preceding the interview. All patients had signed an informed consent statement.

It was adopted a non-probabilistic sampling methods,

according to which the patients were interviewed in order of presentation, constituting a convenience sample. Table 1 shows the composition of the OHIP-14 index. Through interviews, problems have been reported (over the past six months) according to the perception that being classified as the frequency of appearance. The OHIP-14 comprises 14 items that explore seven dimensions of impact: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. The responses were classified using the Likert scale with five options ranging from “never” (0) to “very often” (Tables 1 and 2).

Personal interviews were conducted by a single interviewer, previously trained in the application of OHIP-14 form. To study the reliability of employee questionnaire (OHIP-14) was applied to the alpha-Cronbach coefficient. The results of OHIP-14 scale application were analyzed to applying the additive method due to its high discriminatory power. It calculated the sum of the points for each item per individual, with the scale could have a range of 0 to 56, allowing the calculation of the average OHIP-14; note that the highest value indicates the greatest impact on oral health QoL. The significance level was 5% for decision making.

This study was approved by the Research Ethics Committee (REC) of Faculdades Unidas do Norte de Minas (FU-

Question: ... Because of problems with your teeth, your mouth or your dentures?	Answer: 0=never; 1=rarely; 2=sometimes; 3=repeatedly; 4=always.
1. Have you had trouble speaking a word ...	
2. Did you feel that the taste of the food has gotten worse ...	
3. Did you feel severe pain in your mouth?	
4. You have felt uncomfortable to eat some food ...	
5. You've been uneasy ...	
6. Did you feel stressed ...	
7. His power has been undermined ...	
8. you had to stop your meals ...	
9. Do you have found it difficult to relax ...	
10. Do you ever feel a little embarrassed ...	
11. Do you have angry state with others ...	
12. Have you had difficulty in performing daily activities ...	
13. Have you ever felt that life in general was worse ...	
14. You have been unable to do your daily activities ..	

Table 1: Brazilian OHIP-14 index and response options to the total individual score calculation purposes version.

Domain	Questions
Functional limitation	1-2
Physical pain	3-4
Psychological distress	5-6
Disability	7-8
Psychological disability	9-10
Social disability	11-12
Social disadvantage	13-14

Table 2: Index domains OHIP second presented problems.

NORTE), MG 39404-549, Brazil.

RESULTS

Questionnaire for Internal Consistency of OHIP-14

The internal consistency of the OHIP-14 index given in Tables 1 and 2. Cronbach’s alpha will generally increase as the intercorrelations among test items increase, and is thus known as an internal consistency estimate of reliability of test scores. Our results showed that the internal consistency, estimated through Cronbach standardized alpha coefficient, was considered adequate (Cronbach alpha-0.781). Additionally, alpha-Cronbach values for the different subscales ranged from 0.699 (physical pain) to 0.742 (social limitation). The values of the intraclass correlation show the stability of their items (Table 3).

OHIP-14: Additive Method

The items were prioritized according to the level of impact that

caused the QoL of patients and can be viewed in Figure 1. There was a predominance of physical pain: discomfort to eat and pain; and psychological disability. Considering the frequencies of occurrence, the results showed that elderly people “feel ashamed” and “feel severe pain in the mouth” frequently. On the other hand, “a speech impediment” was observed in 25 patients (Table 4). In addition, Table 4 shows that it has a value of 20.31 for the OHIP-14 index, which can be classified as relatively high impact of oral health on QoL of elderly.

DISCUSSION

The term oral health related to QoL in the field of dentistry is used to describe the impact that oral problems can produce in people’s lives and is determined by a variety of conditions that affect the perception of the individual, his senses and behaviors in exercise of their daily activities.^{2,3}

In Brazil, the demographic and epidemiological transition is a result of declining birth rates, increasing the economi-

Question: ... because of problems with your teeth, your mouth or your dentures?	Average correlation inter item	Alpha-Cronbach
1. Have you had trouble speaking a word ...	0.227	0.735
2. Did you feel that the taste of the food has gotten worse ...	0.223	0.736
3. Did you feel severe pain in your mouth?	0.350	0.723
4. You have felt uncomfortable to eat some food ...	0.540	0.699
5. You’ve been uneasy ...	0.391	0.719
6. Did you feel stressed ...	0.251	0.733
7. His power has been undermined ...	0.493	0.707
8. you had to stop your meals ...	0.472	0.711
9. Do you have found it difficult to relax ...	0.280	0.731
10. Do you ever feel a little embarrassed ...	0.500	0.708
11. Do you have angry state with others ...	0.288	0.730
12. Have you had difficulty in performing daily activities ...	0.308	0.728
13. Have you ever felt that life in general was worse ...	0.364	0.722
14. You have been unable to do your daily activities ...	0.187	0.742

Table 3: Internal consistency of the OHIP-14 second index correlation average inter item and alpha-Cronbach coefficient.

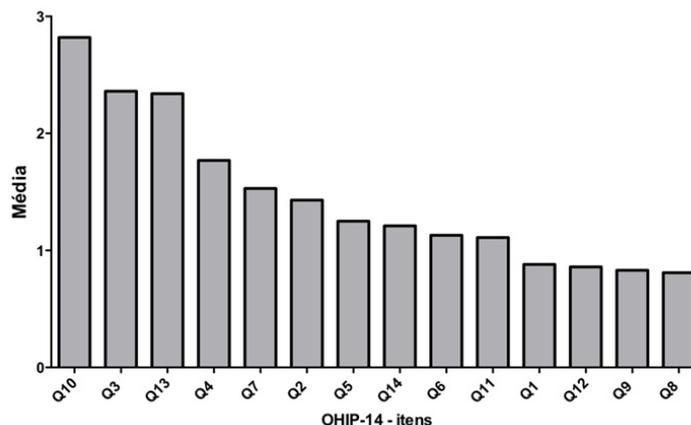


Figure 1: Distribution of ordered items that make up the OHIP-14 index.

Question: ... because of problems with your teeth, your mouth or your dentures?	Never 0	Rarely (1)	Sometimes (2)	Repeatedly (3)	Always (4)
1. Have you had trouble speaking a word ...	54	33	17	0	8
2. Did you feel that the taste of the food has gotten worse ...	31	29	32	13	7
3. Did you feel severe pain in your mouth?	15	13	28	29	27
4. You have felt uncomfortable to eat some food ...	37	12	25	16	22
5. You've been uneasy ...	48	25	18	5	16
6. Did you feel stressed ...	48	24	25	8	7
7. His power has been undermined ...	38	19	27	14	14
8. you had to stop your meals ...	68	16	16	5	7
9. Do you have found it difficult to relax ...	67	20	13	1	11
10. Do you ever feel a little embarrassed ...	11	2	27	28	44
11. Do you have angry state with others ...	55	15	24	11	7
12. Have you had difficulty in performing daily activities ...	67	20	9	6	10
13. Have you ever felt that life in general was worse ...	24	8	22	22	36
14. You have been unable to do your daily activities ...	54	14	23	9	12

Table 4: Frequency and average occurrence of the items that make up the OHIP-14 index.

cally active population, reduction of infectious diseases and increased chronic diseases such as arthritis, diabetes, cardiovascular disorders and rheumatism.^{4,5,12,13} A person to be considered elderly must be 65 years or older, for developed countries, and emerging countries 60 years or more.

The aging process has several aspects, aging is characterized by the declining ability to respond to stress, increased homeostatic imbalance, and increased risk of aging-associated diseases. Also, senility is the age with the development of a pathological condition by emotional stress, injury or illness. Becoming old is a reality experienced by all people. Being old is to live a life cycle where several changes are evidenced throughout life, the need for this social and family interventions. According to the World Health Organization (WHO) in 1948, it defines health not as “absence of disease” but as “a state of complete physical, mental and social well-being”, requiring it to multiple interventions. The elderly people need to be included in the family with care and love, must live in a society in which their constitutional right is guaranteed to have a decent home, enjoy a public health quality and above all be well psychologically within the society in which lives.^{4,5,12,13}

One of the factors that interfere negatively with QoL of older people is, both in the social sphere and in health, is the loss of dental elements whose main factors periodontal disease and caries related to lack of access to oral health. An elderly edentulous is an individual who gets sick psychologically, the loss of self-esteem and can also sicken by the deficiency of chewing and swallowing, contributing to the worsening of diseases of lack of adequate protein to your body.³

Some authors suggest that are very frequently in the oral cavity of the elderly changes that interfere with the taste sensation, such as coated tongue that may be associated with poor oral hygiene, often hampered by diseases such as arthritis. One can also meet certain frequency lingual varicosities, characterized by bubbles that are located on the tongue side, it is most often asymptomatic.^{1,3}

In addition to systemic diseases affected at this age, the oral health of the elderly is still precarious, the number of teeth in the oral cavity is small, the incidence of periodontal disease and caries is high, most make use of partial dentures and/or total, causing the social, physical and psychological problems affecting their QoL.^{1,12}

Although this is not an epidemiological study, the data provide interesting information on the social and oral health conditions of the study group, which, however, can not be generalized, because there was not any attempt to make it a random sampling. In practice, the difficulties to obtain elderly sampling lead researchers to use samples from seniors groups or nursing homes. Still, the study may have limitations on the external validity of the adoption of non-probabilistic methodology in selecting the sampling units but widely used in clinical studies for ease of access to patients. Reliability was assessed by examining internal consistency and reproducibility. For the OHIP-14 instrument, the alpha-Cronbach was 0.78, showing good consistency, similar to those found in other studies. In addition to the OHIP-14 be homogeneous, it is stable, reflecting the effective contribution of each of the issues for the internal consistency of this index.

There was a predominance of physical pain, which comprises “feel bothered by eating some food” and “feeling severe pain in the mouth”. Once pain is the main reason that adults seeking dental care, usually these individuals use sporadically dental service, only when they have symptoms. The difficulty in chewing was associated with QoL in previous studies, where the deterioration of oral health conditions is focused on attention to school children, pregnant women, and babies, focusing on individual and curative care. This study observed high impact of oral health on QoL of patients, where positive responses were found in several other survey questions used by OHIP-14 index; however, having negative impact on oral health, either in functional limitations, psychological discomfort, physical disability or mental disability.

The results of this study suggest that even people with good access to routine dental services may have relatively high OHIP scores, which indicates that there is no good life quality levels related to oral health. Starting from an assumption that the oral health of the elderly is essential to good health in all aspects, it is essential that the professional dentist, along with government agencies, through social to health care policies, review the general concept of oral health for that particular group. Due to the high population growth and survival of the elderly population, become necessary investments in conservative treatment and rehabilitation for preservation or maintenance of oral health of the elderly.^{3,8,11,13}

Thus, it is suggested that subjective issues and psychological aspects are considered as essential as the normative requirements. The use of the OHIP-14 can be useful for planning programs and actions for the health of the elderly, prioritizing those with higher psychosocial impacts produced by dental problems. Thus, actions for health education, with emphasis on self-awareness, self-protection and self-care should be explored, as would enable a greater empowerment of older persons to act with more autonomy in the pursuit of improving the QoL and health.⁶⁻¹¹

CONCLUSION

The OHIP-14 index was consistent and proved to be relatively high impact of oral health on QoL of patients, with a predominance of physical pain in its components “feel bothered to feed” and “feel pain in the mouth” and the components of the psychological impairment. Health authorities must address all these factors when planning interventions on oral health for this population.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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Research

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Cleaning of Dental Handpieces: A Method to Test its Efficiency, and its Evaluation With a Washer-Disinfector-Lubricator-Dryer

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ABSTRACT

Objectives: When using dental handpieces (HP), a phenomenon of backflow leads to an external and internal soiling and contamination of HP, especially in their narrow air/water pipes. To prevent any cross-infection, HP need to be sterilized after a thorough cleaning. This work aims to establish and assess a method for testing their cleaning. Indeed, there is a methodological gap concerning its validation because of their complex architecture.

Materials and Methods: This method is declined into a protocol using artificial soilings and ninhydrin tests. Its evaluation with a washer-disinfector-lubricator-dryer (WDL) within 2 cleaning cycles with each 6 HP and after control tests, heads to validate its relevance and to demonstrate the effectiveness of the cleaning provided.

Results: After each cycle, all HP were externally clean. Our method also showed an internal cleanliness except for 2 HP whose engines in the automaton were defective.

Conclusion: This work fits with the improvement of infection control in dental practices. It is the first method developed to control the internal cleaning of HP without having to break them, and it demonstrates the need for HP to be put into an internal rotation during their cleaning. It fills the methodological gaps concerning their cleaning and allows assessing HP cleaning from dedicated WDL. According to standard NF EN ISO15883, the method could be used for initial steps of operational or performances qualifications concerning HP cleaning.

KEYWORDS: Dentistry; Infection control; Sterilization.

ABBREVIATIONS: WDL: Washer-disinfector-lubricator-dryer; HP: Handpieces; InVS: Institut de Veille Sanitaire.

INTRODUCTION

Historically, dental rotary instruments were used along with foot-powered dental drills.¹ Now-a-days, they are inserted into dental handpieces (HP), and they are put into action with the help of electric motors. These HP are coupled with narrow pipes bringing air and water to cool down the cutting instrument. During a dental surgeon's procedure, the head of the HP is right in the patient's mouth exposing the instruments to the dental organ and soft tissues and in direct contact with saliva or other biological fluids (blood, pus) in a real septic environment. HP is heat-sensitive, and they are classified as semi-critical reusable medical devices according to the Spaulding classification.²⁻⁴ Therefore, they should follow a complete sterilization cycle before their reutilization.

Moreover, when the HP stops working while performing dental procedure, a physical

phenomenon of backflow occurs.⁵⁻¹¹ Since the head of the HP is running in a septic environment, a retro-contamination and an internal soiling (Figure 1) of the HP occurs, consequently causing external contamination and soiling. This contamination takes place at different levels of the head and body of the HP,¹⁰⁻¹⁷ and the narrow pipes dedicated to bring air and water to the dynamic instrument.^{18,19}



Figure 1: Dismantled HP with inner and outer soiling (Courtesy of Dr. JP Mangion).

Indeed, the head of the HP is not isolated from its body, neither in a watertight nor in an airtight way. This clearly appears by applying compressed air at one end of the head and observing an air outlet to the other end.

This internal contamination can spread to the engine that puts the HP in action, and the contamination of the air/water pipes can spread to the entire unit waterline.^{6,8} The latter can then constitute a secondary reservoir of microorganisms which are aggregated in biofilms. These biofilms could potentially grow from microorganisms that come from the mouth of patients and from the general water supply network. Far from being trivial, the contamination of a unit waterline can lead to serious infections, and even death of patients.²¹ Therefore, the risk of infection is real, and the management of this risk should be seriously integrated in the context of the safety of the procedures.²²

If the contaminated HP does not follow an adequate treatment, it can then become a source of cross-infection endangering the health of the following patients and the health of the healthcare team by exposing them to an increasing risk of infections.^{5,6,14,19,20} Contamination of HP can be of various kinds; many pathogens were found in the HP, such as hepatitis B virus,¹³ or *Pseudomonas spp* and *Staphylococcus aureus*.¹⁹ A mathematical modeling conducted by the Institut de Veille Sanitaire (InVS) in 2009 shows that each year in France, the neglected treatment of HP would be responsible for 200 contaminations caused by the virus of hepatitis B, 2 contaminations by the virus of hepatitis C, and one by HIV.¹¹

To expose patients to this infectious risk while there are ways to minimize it, including a correct treatment of HP, is

ethically unacceptable.^{2,5,23} In order to be in good standing with the regulations concerning the treatment of semi-critical medical devices in dentistry, it is necessary, essential and mandatory to sterilize HP between each patient.^{2-5,8-10,14,15,17,18,24-27} To ensure a complete and efficient sterilization of HP and any other instrument, and to ensure that the steam can reach the whole surface that has to be sterilized, the instruments must previously be cleaned.^{3,4,14,20,21,28-30} Many studies also emphasized this point that it is essential that HP benefit from an optimal cleaning to ensure the effectiveness of their sterilization.^{10,12,27,32-34} On one side, the external cleaning of HP does not raise problems. On the other side, great difficulties remain to realize internal cleaning effectively^{22,31,35} mainly because of the complex internal architecture of HP, and the very reduced dimensions of the air/water pipes.^{22,28,34,36}

Many manufacturers have tried to develop an automaton to perform a thorough cleaning of HP, both external and internal. They were faced with the difficulty to develop such an automaton,^{31,33,37,38} because residues still remain on the surfaces which should appear clean, even if the cleaning machine is more effective than the manual cleaning.³¹ Moreover, it is difficult to assess the good internal cleaning of HP because they are fragile and mostly designed not to be dismantled. Literature also raises the question of a proven method to control the good internal cleaning of HP which is a problem concerning HP that are not meant to be dismantled.^{15,28,35} Indeed, the standards for the general requirements of washer-disinfectors performances³⁹ advocates a visual validation of the good cleaning of instruments required to ensure a complete and effective sterilization cycle. If this validation does not raise problems for full instruments, it is not the case for the hollow instruments, neither is it for the ones that should not be dismantled.

OBJECTIVE

The aim of this original study is to develop a validation method of the external and internal cleaning of HP without being destructive. The secondary objective is to assess the method by applying it with a washer-disinfectant-lubricator-dryer (WDL) dedicated to HP.

MATERIALS AND METHODS

Tests have been thought for the operator to be able to visualize the inside of the HP. Since the task is accurate and meticulous, the tests cannot be considered as a routine, and they participate in the originality of our work. The tests took place within 2 cycles according to the following protocol, after having performed control experiments.

Soil Test[®] (Browne/STERIS, Le Haillan, France) was used, and tests with Ninhydrin (CleanTrace[®], 3M, Cergy, France) were also performed in order to assess the presence or absence of protein residues, and therefore validate the surfaces

cleanliness. The WDL used during these tests was the Bioda[®] (vr2m, Semoy, France).

The Protocol

1. Dismantle the HP (Figure 2).
2. Stain the outside (body of the HP) and inside (air/water pipes, gears) using Soil Test[®]. Also, stain the load racks (block support for the HP, sides of the tank). Soil Test[®] was chosen because of the good adaptability of the form in which it is presented to the protocol that is described, and its adequacy with biological fouling.⁴⁰
The head of the HP is stained using a Soil Test[®] syringe. The air/water pipes are stained using a Soil Test[®] syringe whose mouthpiece is suitable for their diameter. The pressure on the plunger of the syringe will be made until the Soil Test[®] comes out by the other side of the pipe.
3. Reassemble the HP.
4. Connect the HP in the automaton (Figure 3), and run a cycle with inactivation of the disinfection phase (as specified in the standard NF EN ISO 15883-1 for washing tests).³⁹
5. Visually observe the presence/absence of soiling residues on the outside of the HP. Perform a test with Ninhydrin (CleanTrace[®]) in case of absence.
6. Dismantle the HP.
7. Visually observe the presence/absence of residues of soiling. Push a 0.7 mm diameter nylon thread through the air/water pipes over a clean plate. The thread is adjusted to the diameter of the pipe and will displace any remaining residual soiling that will be observable upon its release. Observe the pres-

ence of soiling on the end and/or on the body of the thread under the microscope. Observe the presence of deposits on the plate. Perform a test with Ninhydrin (CleanTrace[®]) on the thread in case of absence.

8. Reassemble the HP/start again at point 2. for a new cycle.

Control Experiments

1. Control tests were performed on an artificially soiled HP according to the steps described in this protocol, but without the cleaning step (Step 4).
2. Steps 5 to 8 of the protocol were followed on a HP which was naturally soiled during a normal use in dental surgery practice and treated routinely with a manual cleaning.

First Cycle

The first tests cycle was carried out on 6 universal-fitting HP (valid for HP from brands such as WH[®], BienAir[®], MicroMega[®], Mont Blanc[®], etc.). The cleaning cycle has been set to 15 minutes, using Deconex[®] (Borer Chemie AG, Zuchwil, Switzerland) as detergent at 8 ml/L of water. During the start-up of the cycle, 2 HP were turning on themselves, showing an absence of rotation of the internal bearings. The engine examination of the support brackets confirmed that they were defective.

Second Cycle

The second cycle was carried out on the same 6 universal-fitting HP, previously cleaned before being soiled again using Soil Test[®]. The cleaning cycle has been set to 4 minutes, using the

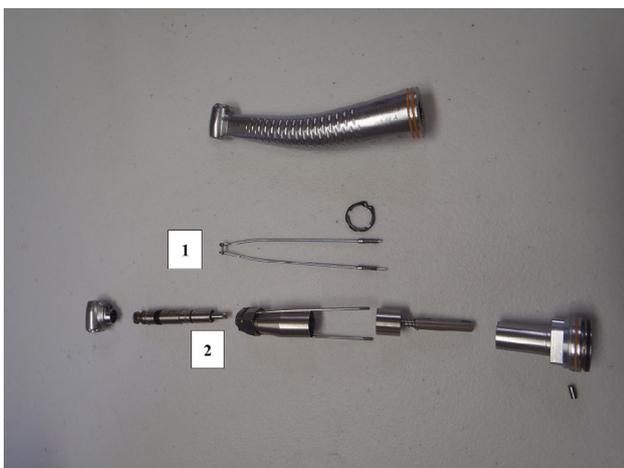


Figure 2: Dismantle of the HP.

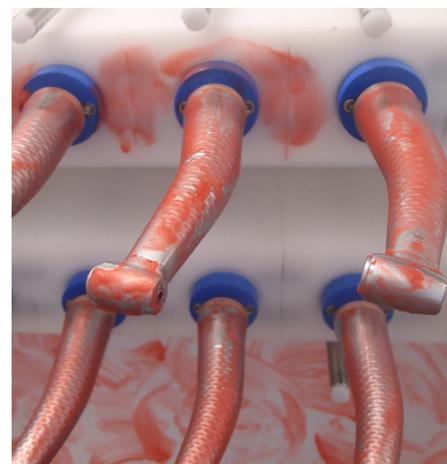


Figure 3: Connection of the soiled HP in the automaton. Soiled load racks and tank sides.

VR-DYME® (vr2m, Semoy, France) as detergent. The engines were changed and during the cycle, the entire HP has shown in internal rotation.

RESULTS

Control Tests

1. The control tests confirm the presence of Soil Test® in the air/water pipes and validate the relevance of pushing the nylon thread through these, because the thread highlights the internal staining of these pipes (Figure 4).
2. The control test on the HP stained during a normal use and treated manually in routine shows residues inside the head of the HP (Figure1) and the air/water pipes. Ninhydrin tests have been performed by swabbing the thread in both situations, and the results were positive (turning to purple) (Table 1).

First cycle

At the end of the washing cycle (15 minutes), HP have been disconnected from the WDL and handled with gloves. Visual examination showed a lack of residual soiling on the body of the

HP as well as on the load racks.

After dismantling the HP, the areas likely to be soiled in a usual dental surgeon’s practice appeared to be clean on the 4 HP for which the motor worked properly. The nylon thread in the pipes showed neither deposit on the thread itself nor on the plate over which it was conducted (Figure 5). Ninhydrin tests were performed on these soiless surfaces, and the results were negative. Concerning the 2 HP which had not been put into an internal rotation, a residual soiling was apparent on the half of the surface of one gear, the other half appeared clean (Table 1). This is shown on Figure 6 through the blue marker and demonstrates the importance of the internal rotation of the HP during the cleaning cycle.

Second cycle

At the end of the washing cycle (4 minutes), the HP have been disconnected from the WDL and handled with gloves. Visual examination showed a lack of residual soiling on the body of the HP as well as on the load racks.

After having dismantled the HP, the areas likely to be soiled in a usual dental surgeon’s practice appeared to be clean.

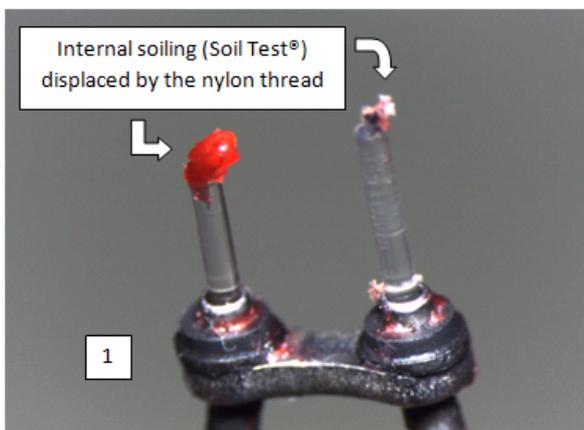


Figure 4: Highlighted interest of pushing a nylon thread through the air/water pipes.

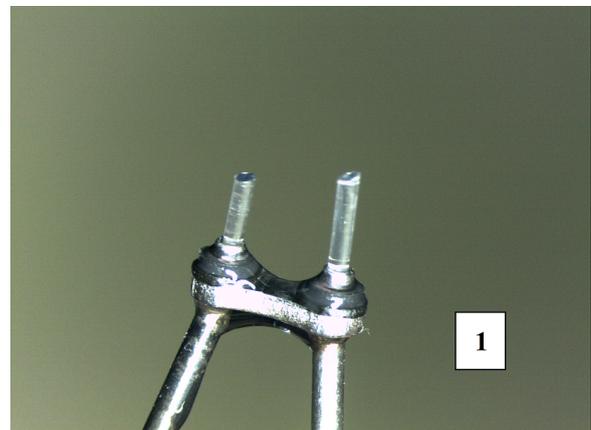


Figure 5: Highlighted cleanliness of the air/water pipes of the HP.

Experiment	Type of soiling	Number of HP	Protocol steps	Cleaning modalities	Results
Control test 1	Soil Test®	1	All but 4	No cleaning	External and internal soiling
Control test 2	Soiling during normal use in dental practice	1	5 to 8	Manual cleaning	External cleanliness Internal soiling
1 st cycle	Soil Test®	6	1 to 8	WDL with Deconex®	External cleanliness Internal cleanliness except for 2 HP whose engine on the support brackets were defective
2 nd cycle	Soil Test®	6	1 to 8	WDL with VR-DYME®	External and internal cleanliness

Table 1: Modalities and results of the tests.



Figure 6: Highlighted soiling on the half of the same gear, due to the non-internal rotation of the HP.

Ninhydrin tests were performed on these soiless surfaces and were negative.

The nylon thread in the pipes showed no deposit on the thread itself, or on the plate over which it was conducted. Ninhydrin tests were performed on the nylon threads, and the results were negative (Table 1).

DISCUSSION

This protocol is the first protocol proposed to control the internal cleaning of the HP without having to destroy them. Such a method of evaluation can easily be used in the initial steps of an operational qualification or a qualification of the performance of a WDL. Indeed, the standard for the general requirements of washer-disinfectors performances³⁹ demands a primary validation of the cleaning of the HP using an artificial soiling before their use in an actual practice.

In two cycles, the tests show the effectiveness of the cleaning. Indeed, the HP and the load racks appear clean after the two cycles (15 minutes, and even after a shorter cycle of 4 minutes). Disassembly also shows a cleaning efficiency in the visible areas beneath the body of the HP and into the air/water pipes as well. Finally, the results of these tests are confirmed by the absence of reaction with Ninhydrin.

The tests also show that it is essential that the HP kept in internal rotation (as it is when they are used by the dental surgeon as he is working in the patient's mouth) during the cleaning process. Indeed, a lack of internal rotation, as it was the case for 2 HP in the first cycle produces an incomplete cleaning because fluids cannot reach all the surfaces.

This validation method is consistent with the initial applications of standard NF EN ISO 15883 concerning the cleaning of the instruments. However, some limits should be mentioned; since the final validation of the cleaning is based on a visual assessment (as required in the standard NF EN ISO 15883), it is impossible to scientifically ensure the good cleaning inside the parts of bearing without damaging the equipment, because they are not removable and are not accessible to swabs or ny-

lon threads. The protocol appears to be meticulous to achieve, and the manipulations are very delicate because they were made on HP that are not designed to be disassembled and once items are removed, they are easily breakable. It may very well find its place into the initial qualifications of an automaton dedicated to the treatment of the HP, but it seems hardly applicable to periodic requalification of these automata in a routinely dental practice.

Other tests may be performed in the future in order to strengthen the relevance of this method in order to optimize the automaton washing time and to assess the performances of any other WDL.

CONCLUSION

HP's are reusable semi-critical medical devices that generate soilings and contaminations through the backflow phenomenon inter alia located on the outer surface, inner surface and in the narrow air and water pipes. This initial contamination can become the source of cross-contaminations. Additionally, the good treatment of HP is a regulatory obligation that must follow a sterilization process between each patient, preceded by an effective cleaning.

The validation method of the cleaning of the HP presented in this article clearly fits with an approach of improving the safety of practices, and the management of the risk of infection in dental care procedures, both for patients and for the healthcare team. It fills the methodological gaps concerning the cleaning of the HP as required in the standard NF EN ISO 15883. Although its implementation is meticulous and accurate, it allows at lower cost to assess the HP cleaning.

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CONFLICTS OF INTEREST

All authors report no conflicts of interest relevant to this article.

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