What's new for the clinician – summaries of recently published papers (October 2023)

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Edited and compiled by Prof V Yengopal, Faculty of Dentistry, University of the Western Cape

1. The impact of electronic and conventional cigarettes on periodontal health – a systematic review and meta-analysis

According to the World Health Organization (WHO), tobacco kills more than 8 million people each year, including 1.3 million non-smokers who are exposed to second-hand smoke. Around 80% of the world's 1.3 billion tobacco users live in low- and middle-income countries. In 2020, 22.3% of the world's population used tobacco: 36.7% of men and 7.8% of women.

Regular smoking can cause various pathologies such as cancer, cardiovascular disease, respiratory disorders and periodontitis and is the single most preventable cause of death worldwide[1]. Triggers for many pathologies include more than 90 proven carcinogenic and toxic cigarette substances, some resulting from the burn process. These include polycyclic hydrocarbons, nitrosamines and aldehydes[1]. Electronic nicotine delivery systems (ENDS) (eg electronic cigarettes, vaporisers, vape pens, shisha pens and e-pipes) are said to prevent the formation of unwanted products by bypassing the combustion process.

The tobacco industry and related industries market and promote ENDS as "safer" alternatives to traditional cigarettes, and many users consider them to be significantly "less harmful" than tobacco products, particularly cigarettes[1]. Consequently, their use – especially among younger and first-time smokers – has grown exponentially over the past few years.

Since the oral cavity, the first upper respiratory tract station, is the primary exposed region when smoke is introduced, the influence on oral health, more especially on periodontal health, is significant. Current studies have proven that smoking and vaping are risk factors (ENDS: odds ratio = 2.3, 95% confidence interval (CI) = 1.52 to 3.59; conventional cigarettes: odds ratio = 2.2, 95% CI = 1.76 to 2.68) for periodontal disease.[1] Thiem and colleagues (2023)[1] from Germany reported on a systematic review with meta-analysis that sought to determine whether and to what extent the consumption of ENDS bears advantages and disadvantages on periodontal health (bleeding on probing (BoP), plaque index (PI), probing depth (PD), attachment loss (AL), marginal bone loss (MBL), tooth loss, molecular inflammation markers, salivary flow rate) compared to conventional cigarette smoke and non-smokers.

METHODOLOGY

This meta-analysis was performed based on the recommendations and principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Statement (PRISMA). The focused PI(CO) question addressed was as follows: "To what extent does oral health differ between e-cigarette users, cigarette smokers or non-smokers?"

- "Population": e-cigarette users, smokers and non-smokers
- "Intervention": clinical inspection of the oral mucosa, radiographic imaging and histological assessment
- "Comparison": e-cigarette users, smokers and non-smokers
- "Outcome": bleeding on probing (BoP), plaque index (PI), probing depth, attachment loss, marginal bone loss (MBL), tooth loss, molecular inflammation markers and salivary flow rate

A search strategy with mesh terms was developed and adjusted for different electronic databases including MEDLINE (OVID), Embase (OVID; 2006–04/2022), Web of Science, CENTRAL (The Cochrane Library, 2022) and ClinicalTrials.gov. Articles in German and English were screened.

The inclusion criteria were as follows: (a) studies published between January 2006 and April 2022, (b) all studies that compare the clinical effect of e-cigarettes to conventional cigarettes on oral health, namely periodontal health. The primary examination parameter was bleeding on probing (BoP). Secondary examination parameters included plaque index (PI), probing depth (PD), attachment loss (AL), marginal bone loss (MBL), tooth loss, molecular inflammation markers and salivary flow rate. No selection based on other clinical, histologic or radiographic examination methods as well as age, gender or social origin was conducted. Studies that did not compare inhalation products were excluded, as were studies without a control group other than e-cigarette users (healthy non-smokers or cigarette smokers).

The following items were extracted from publications that met the inclusion criteria: author, year, country, study design, sample size, measures of exposure (smoking status), measures of outcome (BoP, PI, PD, AL, MBL, tooth loss, molecular inflammation markers, salivary flow rate), results, conclusions, conflict of interest and source of funding.

To avoid bias in study selection, abstract screening was performed by two independent reviewers. Discrepancies were discussed afterward and evaluated by a third independent reviewer.

Specific exclusion criteria were established during the literature search to guarantee the review's validity to exclude irrelevant data. Studies were individually pooled, and an effect measure was determined for each. The effect measure of individual studies was then formulated at the review level

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as the overall effect of the intervention. The means and standard deviations calculated in the individual studies were used to merge different scales or rankings. Instead of providing the standardised mean difference as an effect size, the authors converted it to the odds ratio and their respective 95% confidence intervals (CIs). Heterogeneity was tested using Cochran's Q test and quantified using the I-square test (level of inconsistency) and Tau^2 (estimate of between-study variance). The risk of bias in cohort studies was assessed using a modified version of the Newcastle-Ottawa scale (NOS). According to the description, however, the scale refers to cohort and case-control studies. Nevertheless, other observational studies, such as cross-sectional, were assigned to the two subgroups and assessed. To assess the selected studies' quality of evidence and the quality classification for validity control, the GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach, which focuses on evaluating the study design, was performed.

Meta-regressions were used to test the influence of different moderators (age, duration of exposure, frequency of exposure, time of cessation and dropout rates) on pooled estimates. Heterogeneity (I^2) and the amount of heterogeneity accounted for each variable (R^2) were calculated. A funnel plot was established to detect publication bias.

RESULTS

From a total of 923 publications identified, 16 studies were included in the review. Since all studies were non-randomised, they were classified as evidence grade III or IIa according to the Cochrane GRADE tool.

Pooled outcomes for meta-analysis

- **Evaluation of bleeding on probing:** E-cigarette versus cigarette users

The pooled results showed that the odds of a positive BoP were 0.33-fold lower in e-cigarette users than in cigarette smokers ($p = 0.03$) Furthermore, it was checked whether publication bias was present. Based on the funnel plot publication bias was excluded.

Meta-regression revealed that the age of cigarette smokers did not affect the pooled effect size ($\beta = -0.02$; $p = 0.79$). Therefore, a higher age does not increase the odds ratio, indicating equal chances of positive and negative BoP among e-cigarette users and cigarette smokers. Likewise, there was no effect of the duration of use of conventional cigarettes ($\beta = -0.03$; $p = 0.64$) or e-cigarettes on the pooled effect size ($\beta = -0.04$, $p = 0.83$). Moreover, neither daily e-cigarette use ($\beta = -0.04$; $p = 0.09$) nor everyday use of cigarettes ($\beta = -0.22$, $p = 0.04$) affected the pooled effect size. The chance of bleeding (positive BoP) is equal between e-cigarette smokers and smokers in the case of increased consumption. The remaining influencing variables and moderator variables were not significant.

- **Evaluation of bleeding on probing:** E-cigarette users versus non-smokers

When comparing e-cigarette users and non-smokers, significant heterogeneity between studies was evident ($Q(6) = 120.3$; $p < 0.0001$), leading to the application of the random effects model with $I^2 = 95\%$ and $\tau^2 = 12.8$. The pooled odds ratio indicated that e-cigarette users have a significantly lower chance for positive BoP than non-smokers ($p < 0.01$). When assessing for publication bias, effect sizes were distributed asymmetrically in the funnel plot, suggesting publication bias.

To counteract the publication bias, the trim-and-fill method was applied to estimate the number of additional studies required to minimise the effect of bias and to achieve a symmetric distribution. The following forest plot is augmented with studies according to the above methodology. As a result, significant heterogeneity occurred ($Q(6) = 71.07$; $p < 0.001$). To quantify the heterogeneity, $I^2 = 96\%$ and $\tau^2 = 21.87$ were calculated, indicating the presence of considerable heterogeneity. The random effects model yielded a pooled effect size of 0.01, resulting in a 0.01-fold decreased chance of a positive BoP result in e-cigarette users compared with non-smokers ($p < 0.01$)

No pooled effect analyses for the other variables were attempted due to the lack of studies or heterogeneity between the studies.

CONCLUSION

Based on the present results, it can be summarised that e-cigarette use might be considered a healthier alternative to cigarette smoking concerning periodontal health. Even so, harmful effects of electronic nicotine delivery systems (ENDS) usage on periodontal health were seen as well. Due to the lack of standardisation among studies and randomised controlled trials, more research is required to conclusively pronounce on this controversial product.

IMPLICATIONS FOR PRACTICE

The harmful effects of e-cigarettes appear to be less obvious when compared to conventional smoking but clinicians need to continue their efforts to educate their patients on the harmful effects of nicotine containing products.

REFERENCE

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2. Immediate versus conventional loading of mandibular implant-retained overdentures: a 3-year follow-up of a randomised controlled trial

In edentulous patients, the use of conventional dentures has offered the benefit of providing improvement in function and aesthetics. More recently, the introduction of implant-supported overdentures has become a better treatment option for edentulous patients. In fact, the implant-supported overdenture is considered as the first choice of standard care for edentulous patients because it offers a higher retention and stability provided by the attachment mechanism, opposing successful conventional maxillary dentures.[1] The robust evidence in literature currently leads many clinicians to recommend treatment of completely edentulous individuals with implant mandibular overdentures (IMO) retained by 2 implants using a conventional loading (CL), regardless of implant diameter, due to the cost-benefit effective nature of this treatment and the rapid increase in patient satisfaction[1]. However, patients who have undergone CL treatment have reported discomfort and trauma while using conventional complete dentures during the 3-month waiting period before occlusal loading. The instability and lack of retention of the provisional dentures have resulted in inadequate function, adding to the patient's overall discomfort[1]. Studies have demonstrated that immediate

loading (IL) is able to improve oral health-related quality of life (OHRQoL) faster than CL and that satisfaction with IMO generally increases progressively from the first months to the second year, along with comfort, aesthetics and the ability to masticate and speak.

Possebon and colleagues (2023)[1] reported on a trial that sought to evaluate the differences in peri-implant health, marginal bone level (MBL) and implant survival rates, between CL and IL of IMO retained by two unsplinted narrow diameter implants at a follow-up period of 3 years. The secondary objectives were to compare posterior bone resorption of the mandible, functional and patient-centred outcomes and prosthetic maintenance events between the two groups.

METHODOLOGY

The present longitudinal study is a 3-year annual follow-up of IMO wearers who participated in a 3-month randomised controlled trial (RCT) that compared the performance of IL and CL protocols during rehabilitation with two unsplinted narrow diameter implants (Facility-Equator system) used as IMO retainers. The study format for reporting followed the reported Consolidated Standards of Reporting Trials (CONSORT) guidelines for RCT. Each patient who agreed to participate in the study signed a written informed consent form. IMO users were monitored annually over a 3-year period. In relation, the surgical interventions and prosthetic treatment, two dental implants (NDIs – 2.9×10mm) were inserted in the inter foramen region, approximately 5mm anterior to the mental foramina and a minimum inter-implant distance of 20mm using a traditional single-stage surgical protocol. The implant surgery drill sequence followed the protocol recommended by the implant manufacturer and was executed by an experienced surgeon. The bone strength during the preparation of the bone site and the implant placement were based on subjective perception of the surgeon. The insertion torque was recorded and values greater than 30 Ncm were considered adequate for IL. If IL was adopted, the IMO was loaded after surgery by connecting the O-ring cylinder for the Facility Equator attachment intraorally, using self-curing acrylic resin to fit the system to the internal surface of the prosthesis. In the CL group, the intaglio of the mandibular prosthesis was adjusted and rebased with an intermediate liner until the end of the 3-month bone healing period.

For clinical outcomes, the peri-implant health was assessed through clinical examination of the 4 implant faces to monitor the visible plaque index (VPI), peri-implant inflammation (PI), calculus presence (CP), probing depth (PD) and bleeding on probing (BOP). The implant stability analysis was performed by measuring the implant stability coefficient (ISQ) by connecting an A3 type smartpeg directly to the Equator attachment. The measurements were performed in triplicate on all 4 implant faces using an Ostell device. All clinical evaluation has been made by a calibrated operator.

Radiographic evaluation: marginal bone loss and posterior bone resorption

The marginal bone loss (MBL) and the posterior area index (PAI) were analysed using standardised digital panoramic radiographs and all analyses were performed by a single, calibrated examiner. Radiograph calibration involved calculating the Intraclass Correlation Coefficient (ICC) based on two separate analyses at a one-week interval and the outcome was considered acceptable for a correlation index ≥ 0.80. MBL measurements were made at the mesial and distal side of each implant using the linear measurements tools available in the DBSwin 4.5 software package. The external edge of the implant head was used as a reference point during the evaluation, and the implant length was used as reference to correct distortions. The delimitation of reference and experimental areas traced in digital panoramic radiographs was performed using the Photoshop software, and measurements were subsequently performed in the ImageJ software. The PAI was calculated by dividing the experimental area by the reference area, and the average of the PAIs on both sides was reported as the final PAI value.

Functional and patient-centred outcomes

The masticatory performance (MP) test was used to analyse the masticatory function. In this test, patients were instructed to masticate a 3.7g portion of Optocal test food for 40 chewing cycles, counted by a calibrated operator. The triturated test material was subsequently expelled on filter paper, rinsed with water and dried at room temperature for 7 days. The material was then passed through a sieve stack composed of sieves with decreasing opening sizes (5.6mm-0.5mm) mounted on a sieve shaker for 20 min. The material retained in each sieve was weighed and inserted into the Rosin-Rammler equation to calculate the theoretical opening through which 50% of the particles pass (MPX50) and the particle size homogeneity (MPB). The masticatory efficiency (ME) was calculated as the percentage of material weight retained in the 5.6mm and 2.8mm sieves.

The impact of IMO use on OHRQoL was evaluated through the Dental Impact on Daily Living (DIDL) questionnaire. This questionnaire comprises 36 questions divided into 5 domains that map patient satisfaction regarding appearance, pain, oral comfort, general performance and chewing. The final scores for each domain represent the average score of the questions in each domain, and are classified as dissatisfied (< 0), relatively satisfied (0-0.69) or satisfied (0.7-1.0).

Events related to prosthesis maintenance such as pink nylon O-ring exchanges and prosthesis adjustments were also recorded. The following information was also reported: type of complication, number of patients and number of events.

Biological complications such as mucositis or peri-implantitis were diagnosed as reported in the recent World Workshop on the classification of periodontal and peri-implant diseases. The success of the implants was evaluated according to: the absence of clinical implant mobility, the absence of peri-implant continuous radiolucency, the absence of infections, persistent pain and discomfort, and marginal bone loss < 1.5mm. Implant failure was defined by its absence from the mouth or determined when a condition manifests that requires its removal, such as radiolucency around the implant, mobility, suppuration, pain or pathological processes such as osteonecrosis, overloading or advanced peri-implantitits. When implants are still in function in the follow-up, they are categorised into the survival category; survival rates were calculated at 2 and 3 years.

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RESULTS

Three losses were registered during initial 1-year follow-up, 2 in the CL group (1 male and 1 female) and 1 male in the IL group. Thus, the remaining sample of the CL group comprised 6 females and 2 males with an average age of 68.9 years and a mean time since mandibular edentulism of 25 years. The IL group comprised 5 females and 3 males with an average age of 70 years and a mean time since mandibular edentulism of 27.4 years. Five implants were lost (3 IL and 2 CL) during the first year resulting in the survival rate of 90% in the CL group and 85% in the IL group. After replacement with new cone morse implants (ø = 3.5 × 9mm, Titamax Cone Morse Implant), no implants were lost between 1 and 3 years. These cone morse narrow diameter implants were not included in the subsequent analysis. In the CL group, 1 patient had mucositis in the right implant; this condition was absent after 3 years of treatment.

The inter-group analysis (IL vs CL) showed differences between the IL and CL groups in the second year, with significantly lower PD ($p < 0.01$), VPI ($p = 0.03$) and MPB ($p < 0.01$). At year 3, only the MBL differed between the groups ($p < 0.01$), as the IL group presented less bone loss in the peri-implant region ($\Delta = -0.04$). For the prosthesis-related complications and maintenance events, no differences were observed between both groups after 2 and 3 years.

The changes over time for the CL group indicated that the average implant stability coefficient (ISQ) in the 3rd year increased significantly compared to the 1st year (+5.47%, $p < 0.01$). The Visible Plaque Index (VPI) doubled between the 2nd and the 3rd year ($p < 0.01$), while the marginal bone loss (MBL) increased slightly (+4.17%, $p < 0.01$). The bone area of the posterior region increased by 5.83% between the 1st and the 2nd year ($p < 0.01$), followed by a minor but significant reduction of 0.79% in the third year ($p < 0.01$). In the CL group, 2 out of 8 individuals (25%) experienced loss of posterior bone area at the end of the 3rd year. There were significant reductions in average triturated particle size (MPX50 -11.25%, $p = 0.04$) between the 1st and the 2nd year, followed by an increase in the 3rd year (MPX50 + 5.19%, $p < 0.01$). The homogeneity of the triturated food particles (MPB) differed significantly at all evaluation periods (1-2 years, $p < 0.01$; 1-3 years, $p < 0.01$; 2-3 years, $p < 0.01$) and a 9.56% increase in heterogeneity was observed between years 2 and 3. The % retention in the 5.6mm sieve (ME5.6) increased significantly ($p < 0.01$) between years 2 and 3 resulting in an overall increase between year 1 and 3 of 3.35% ($p = 0.02$), reflecting a minor decrease in capacity to triturate coarse particles. Conversely, the ME2.8 values showed a minor but significant increase ($p = 0.02$) of 5.10% between 1 and 3 years.

The changes over time for the IL group indicate changes in clinical outcomes over the entire follow-up period, with an increase of 12.20% in ISQ ($p = 0.04$) between the 1st and the 3rd year, alongside a 13.16% increase in the probing depth ($p < 0.01$). In addition, the MBL increased significantly (MBL +16.66%; $p < 0.01$) between the 1st and the 3rd year, and a progressive reduction in the posterior bone area (PAI) between the 1st and 2nd year (PAI -5.26%, $p < 0.01$) and between years 2 and 3 (PAI -0.93%, $p < 0.01$). In the IL group, 5 out of 9 individuals (56%) experienced loss in the posterior bone area at year 3. The average triturated particle size reduced by 6.44% between years 1 and 2 ($p = 0.03$), and subsequently increased by 7.18% between years 2 and 3 ($p = 0.04$). The percentage of particles retained in the 5.6mm sieve reduced by 43.75% between years 2 and 3 ($p = 0.04$), whereas the percentage retained in the 2.8mm sieve reduced by 0.32% between years 1 and 2 ($p < 0.01$).

The only OHRQoL difference between groups occurred in the first year for the pain domain (coefficient: 0.50; 95% confidence interval (CI: 0.12-0 0.87; $p < 0.01$). In the CL group, the score in the oral comfort domain slightly increased between years 1 and 3 (coefficient: 1.21; CI: 0.26-2.17; $p < 0.01$). In the IL group, the pain domain scores reduced by 1.12% between years 1 and 2 (coefficient: 1.83; CI: 0.39-3.27; $p < 0.01$), followed by a slight increase of 2.24% between years 1 and 3 (coefficient: -2.00; CI: -3.78 to -0.21; $p = 0.02$). The oral comfort domain scores increase of 22.97% between years 1 and 2 (coefficient: 2.10; CI: 0.65-3.56; $p < 0.01$), while general performance scores increased by 1.05% (coefficient: 1.45; CI: 0.91-1.99; $p < 0.01$) and reduced by 10.52% between years 1 and 3 (coefficient: -0.23; CI: -0.36 to -0.10; $p < 0.01$). All individuals had a final satisfaction score greater than 0.7, showing everyone was satisfied with their rehabilitation regardless of the loading protocol adopted.

CONCLUSION

Although IL patients experienced the lowest MBL after 3 years, all the outcomes evaluated in this RCT showed that both loading protocols result in predictable medium-term rehabilitation when monitored annually. It can be expected that in the third year of function, IL patients may present more complaints related to general performance even with acceptable masticatory function and self-reported improvements in oral comfort.

IMPLICATIONS FOR PRACTICE

Both loading protocols led to predictable results. This implies that the decision to use CL or IL must be a considered and patient specific decision made between clinician and patient.

REFERENCE

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