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# Examining the correlation between the "O'Leary" and "Ainamo and Bay" indices

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## Abstract

The present study is designed to determine whether a correlation exists between the O'Leary Plaque Index and the Ainamo and Bay Gingival Index. The two indices are among the most commonly used in the daily clinical practice of periodontists. Plaque indices find their application in establishing whether periodontal disease is plaque induced or not. They are also applied to give the dentist an initial insight into the patient's level of personal oral hygiene and are very often used as patients' motivation to maintain better plaque control. Gingival indices are used in practice to determine whether gingival inflammation is present and therefore to determine the extent of its prevalence.
The study included 30 patients who needed periodontal treatment. The O'Leary and Ainamo and Bay indices were recorded in two stages. The first was immediately prior to treatment initiation and the second was at the reassessment stage after the Hygiene Phase (6-8 weeks). The results demonstrated a significant improvement in the performance of both indices ("O'Leary" showed a difference on average of 82.50% to 16.00%, while "Ainamo and Bay" from 75.80% to 11.60%). The close correlation available between the two indices is noticeable. In conclusion, patient motivation and education during the Hygiene Phase are of utmost importance, as improved personal oral hygiene of the patient inevitably affects the Plaque Index scores, which also reflect on the Gingival Index scores, closely related to periodontal health.

***Keywords:*** Plaque index, Gingival index, Oral hygiene status

## *Introduction*

Bacterial plaque, also known as dental plaque, is a structured biofilm made up of food particles, salivary chemicals, and microbes that develops on the surfaces of teeth. This biofilm forms gradually and can cause a number of oral health problems, such as dental caries, gingivitis, and even periodontitis, if it is not carefully eliminated by brushing or flossing teeth. (1) Regarding periodontal diseases, the pathophysiology of both gingivitis and periodontitis is influenced by

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microorganisms found in dental plaque. The host's immune system reacts proportionately to a developing dysbiosis. This reaction is completely reversible and manifests as "plaque-induced gingivitis," which is characterized by a number of general inflammatory alterations in the tissues. (2) The immune system of the compromised host mounts an excessive but futile defense when dysbiosis becomes frank and the biofilm is adverse. Periodontitis and accompanying permanent tissue alterations, including loss of attachment, bone resorption, and the creation of pockets, are caused by this hyperinflammatory response. (3) But it's important to keep in mind that while some microbes in the dental biofilm are essential for starting the typical signs of periodontitis, they are not enough to cause the disease to develop. (4)

Because it makes it possible to avert and heal dental and periodontal diseases, one of the main objectives of the therapy is to remove plaque and calculus. (4, 5) The methods of removing deposits of dental plaque and tartar are classified as professional and domestic. (4, 6)

Therefore, in addition to the dentist's thorough work during the hygiene phase in periodontal treatment, the dentist's work alone is not sufficient. (6) Personal oral hygiene is fundamental to the health of both the hard dental tissues and the periodontium. However, in order to maintain good personal oral hygiene, every patient needs more or less motivation and training. (1) Motivational interviewing is a technique that has gained popularity recently and is showing promise in bringing about long-lasting change and improvement in health treatments. (7, 8)

The significance of assessing patients' oral hygiene condition using plaque indices is explained by the previously indicated cause-and-effect relationship between biofilm presence and dental and periodontal disorders. As a result, the doctor should think of achieving an effective oral hygiene index as a pertinent objective. In recent years, numerous indices have been suggested and altered for this purpose. (9)

Today, there are a huge variety of plaque indices that dentists use. (9, 10) One of the most commonly applied plaque indices is that of O'Leary. The reason for this probably lies in its simplicity of implementation (by visualizing the plaque), reporting (presence or absence of dental plaque in the respective examined surface) and calculation (the number of areas with a positive result, relative to the total number of examined tooth surfaces, by 100). (11, 12) In addition, specialists today prefer to use indices that evaluate all tooth surfaces for greater accuracy in estimating prevalence. (4)

The palette of diverse gingival indices on the table is not small either. (13, 14) While some merely classify bleeding as occurring or not, others attempt to determine the degree of bleeding by grading. (14) Ainamo and Bay created the Gingival Bleeding Index (GBI) in 1975 as a way to measure gingival inflammation by determining whether or not there is bleeding when the gingival crevice is gently probed. (15)

## *Aim*

The purpose of the present study was to determine whether a correlation exists between the O'Leary Plaque Index and the Ainamo and Bay Gingival Bleeding Index.

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## Material and Methods

This study conforms with the Medical University of Varna's Research Ethics Committee's procedure criteria. The study was conducted in the period from 2022 to 2023 at the Faculty of Dental Medicine, MU-Varna. Patients included were non-smokers, aged between 18-65 years, signed an informed consent declaration and after analysis of the anamnestic data were registered as patients in good general medical condition and without evidence of systemic diseases. In addition to all this, each of the enrolled patients provided information that they had not been given any motivation and education to observe proper personal oral hygiene.

In all enrolled patients, the O'Leary Plaque Index and the Ainamo and Bay Gingival Bleeding Index were examined in two stages. Their first recording was immediately before starting periodontal treatment. The second measurement of the indices was at the reassessment stage, which was carried out in all patients between 6 and 8 weeks after the Hygiene Phase of periodontal treatment was started. It is important to note that motivational interviewing and an individualized teaching approach was applied to each patient during the Hygiene Phase through demonstration of the different mechanical tooth cleaning methods. Appropriate personal oral hygiene products were individually prescribed to each patient.

The Plaque Control Record or the "O'Leary" Plaque Index was introduced back in 1972. This plaque index was developed with the idea of allowing the dentist a simpler method of assessing the dental plaque in the oral cavity of their patients, while being as objective and accurate as possible. In O'Leary, dental plaque is initially stained with an agent, then each tooth surface examined is scored "+" or "-" according to whether or not dental plaque is present. Finally, the percentage ratio of the sum of the surfaces with plaque present to the total number of surfaces examined is calculated. (11)

The Ainamo and Bay Gingival Bleeding Index was introduced with a similar aim to the O'Leary Plaque Index - to find a simple, easy to implement and at the same time as objective an index as possible, which nevertheless assessed gingival inflammation. For every site examined, a positive result (bleeding) or negative result (no bleeding) is noted in this straightforward index. The overall degree of gingival inflammation is then represented by the percentage of bleeding spots. (15)

## Results

Thirty male and female patients, aged 30 to 65 years, presenting to the hospital with evidence of periodontal disease were included in the study.

The index systems used were modified as six tooth surfaces were examined instead of four (Mesio-facial, Facial, Disto-facial, Mesio-lingual, Lingual, Disto-lingual). This modification has been done for the purpose - greater accuracy in the results. The results obtained during the registration of the two indices are presented in Table 1.

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**Table 1. Results obtained during the registration of the two indices**

| | Plaque index O'Leary (Initial visit) | Plaque index O'Leary (6-8 weeks after completion of Hygiene phase) | Gingival index Ainamo and Bay (Initial visit) | Gingival index Ainamo and Bay (6-8 weeks after completion of Hygiene phase) |
|---|---|---|---|---|
| 1 | 79.00% | 15.30% | 74.00% | 10.40% |
| 2 | 83.00% | 10.20% | 77.00% | 9.00% |
| 3 | 37.00% | 9.00% | 32.00% | 7.90% |
| 4 | 96.00% | 16.20% | 92.00% | 10.20% |
| 5 | 93.00% | 15.80% | 92.00% | 13.20% |
| 6 | 95.00% | 13.70% | 89.00% | 8.00% |
| 7 | 78.00% | 17.00% | 76.00% | 12.00% |
| 8 | 68.00% | 13.30% | 47.00% | 6.80% |
| 9 | 41.00% | 12.50% | 37.00% | 4.90% |
| 10 | 98.00% | 18.80% | 94.00% | 16.00% |
| 11 | 98.00% | 18.40% | 97.00% | 13.80% |
| 12 | 99.00% | 18.00% | 90.00% | 12.40% |
| 13 | 81.00% | 12.50% | 78.00% | 8.00% |
| 14 | 97.00% | 9.00% | 95.00% | 5.60% |
| 15 | 94.00% | 18.60% | 88.00% | 10.00% |
| 16 | 92.00% | 9.00% | 90.00% | 8.20% |
| 17 | 84.00% | 21.00% | 73.00% | 14.90% |
| 18 | 82.00% | 17.20% | 66.00% | 13.10% |
| 19 | 82.00% | 15.30% | 76.00% | 12.00% |
| 20 | 100.00% | 23.40% | 98.00% | 18.00% |
| 21 | 100.00% | 25.10% | 100.00% | 20.20% |
| 22 | 100.00% | 22.70% | 100.00% | 18.90% |
| 23 | 76.00% | 16.80% | 75.00% | 9.90% |
| 24 | 83.00% | 15.00% | 73.00% | 12.10% |
| 25 | 69.00% | 12.90% | 52.00% | 8.00% |
| 26 | 100.00% | 29.00% | 100.00% | 21.00% |
| 27 | 76.00% | 10.10% | 63.00% | 9.00% |
| 28 | 80.00% | 26.00% | 67.00% | 16.20% |
| 29 | 32.00% | 9.00% | 25.00% | 8.60% |
| 30 | 83.00% | 10.50% | 59.00% | 10.00% |

The initial registration of the O'Leary Plaque Index found that the arithmetic mean calculated percentage was 82.50%. At the stage 6-8 weeks after the completion of the Hygiene Phase of periodontal treatment, the arithmetic mean percentage of the same index was 16.00%. These

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percentages demonstrate exceptionally good results related to compliance with excellent personal oral hygiene by all patients included in the study. Figure 1 illustrates the results for all 30 patients.

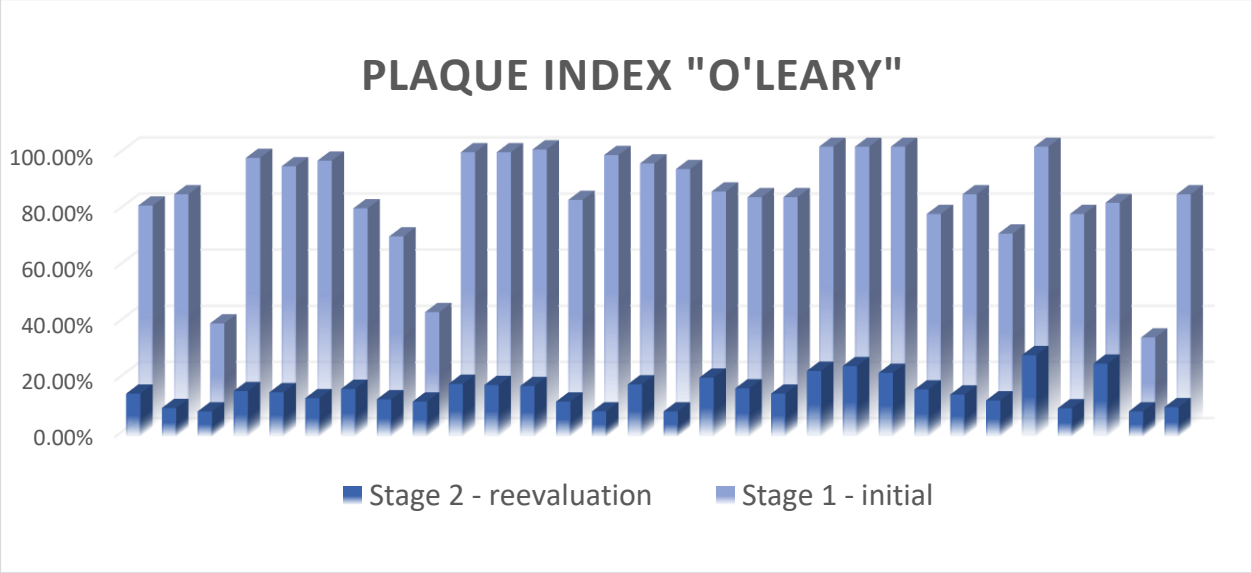


**Figure 1. Plaque Index O'Leary**

In the initial registration of the Gingival Bleeding Index "Ainamo and Bay", it was found that the arithmetic mean calculated percentage was " of 75.80. At the stage of 6-8 weeks after completion of the Hygienic Phase of periodontal treatment, the arithmetic mean percentage of the same index was 11.60%. These percentages demonstrate extremely good results related to the control of the inflammatory process in each of the patients involved. Figure 2 illustrates the results for all 30 patients.

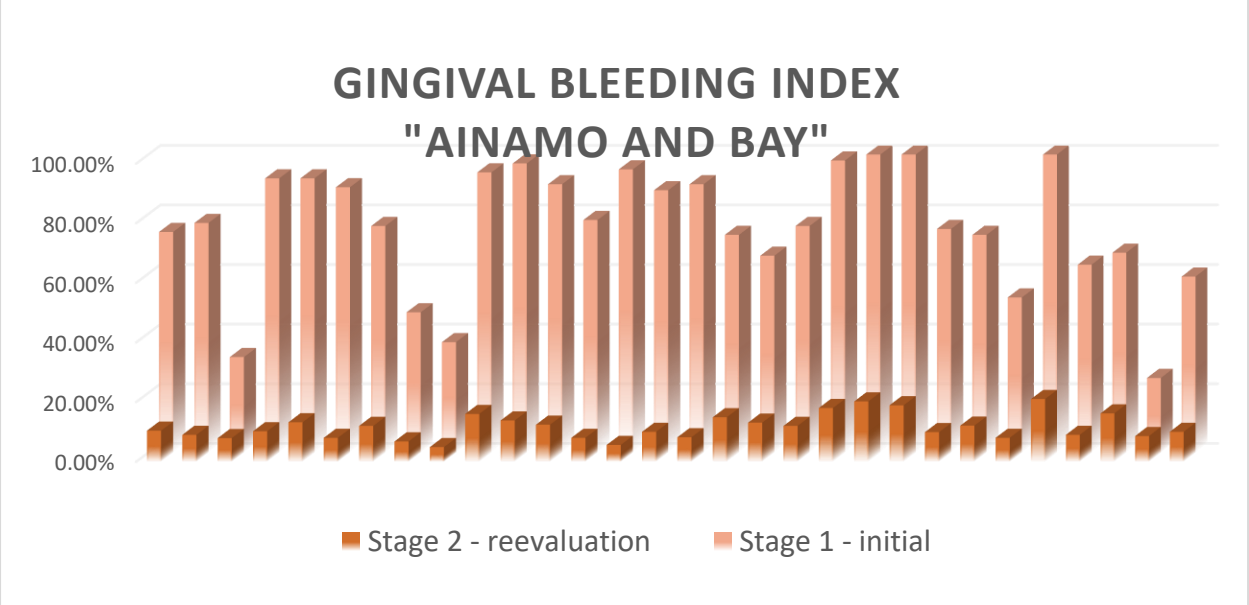


**Figure 2. Gingival Bleeding Index "AINAMO AND BAY"**

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Figure 3 and Figure 4 present the results of the two indices at the initiation and reassessment stages, respectively. Clearly visible is the correlation between the results of the O'Leary and Ainamo and Bay indices at both registrations.

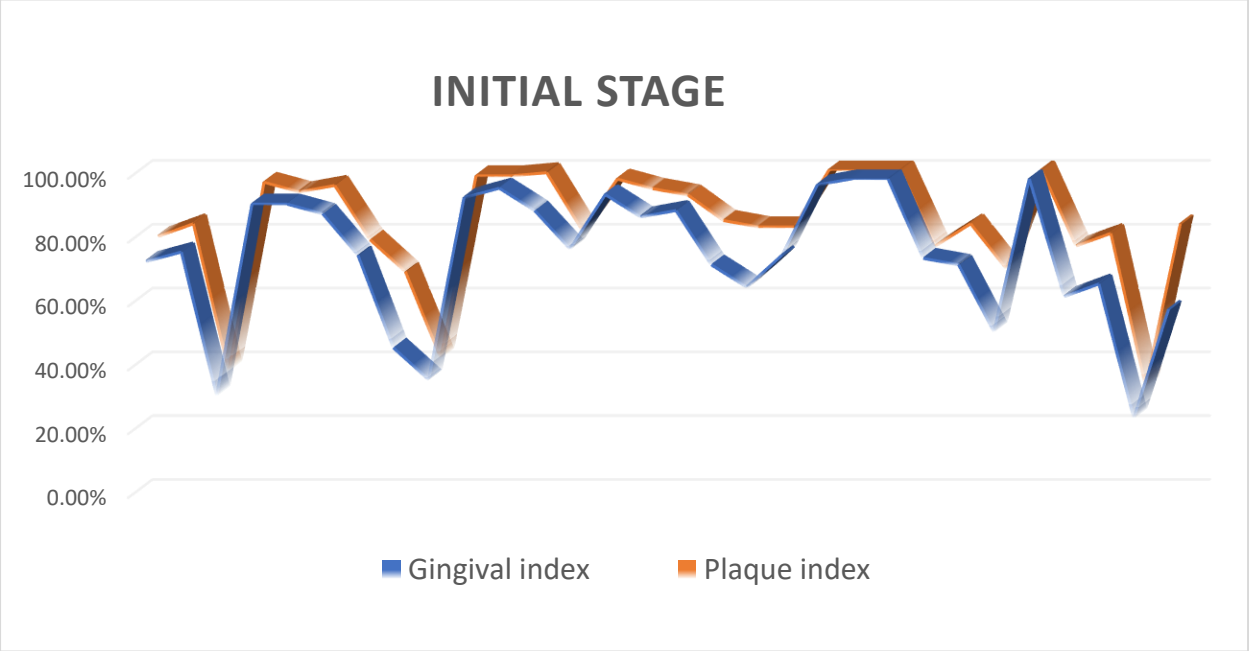


**Figure 3. Initial stage results for Gingival and Plaque indices**

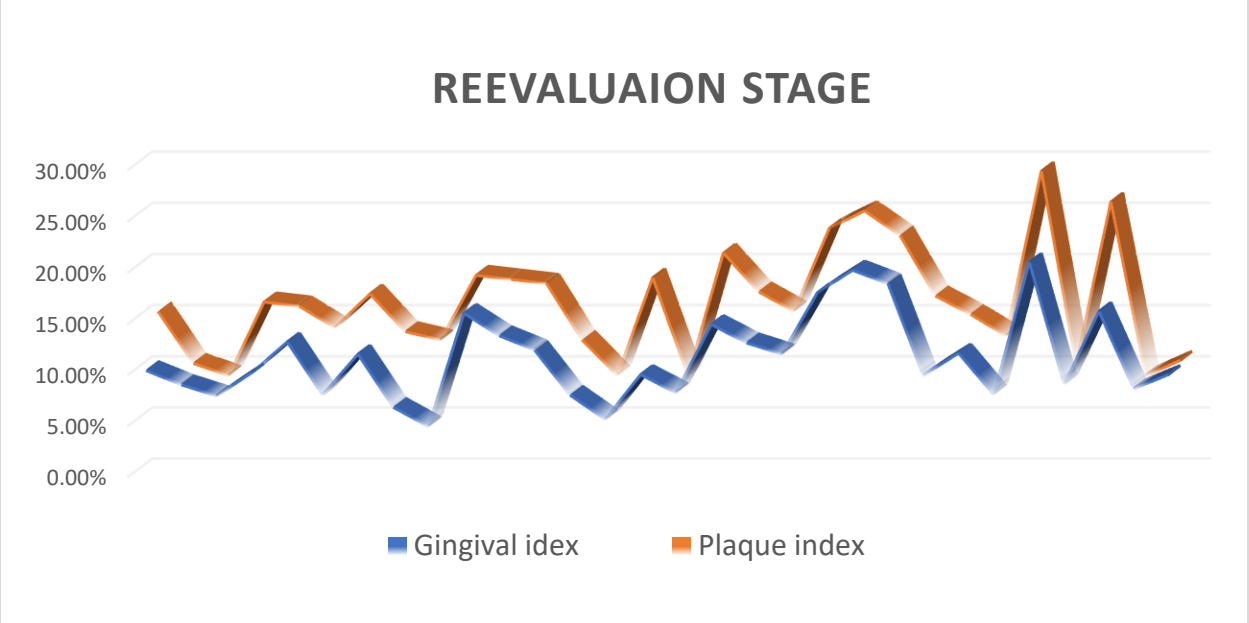


**Figure 4. Reevaluation stage results for Gingival and Plaque indices**

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## *Discussion*

Gum inflammation brought on by bacteria is the cause of periodontal disease. Although mild cases of gingivitis can be managed with good oral hygiene, periodontitis may eventually develop if the inflammation is not reduced. (16, 17)

In a 2020 study, Lertpimonchai et al. confirmed the close association between patients' personal oral hygiene and the development of periodontitis. According to the researchers, there is a two to five times greater chance of developing periodontitis if one practices fair or poor oral hygiene. Regular brushing and dental checkups can lower this risk. (17)

Plaque indices find their application in establishing whether periodontal disease is plaque induced or not, they are also used to give the dentist an initial insight into the patient's level of personal oral hygiene, and are very often used to motivate the patient to maintain better plaque control. (9, 10)

The first signs of gingivitis are gingival inflammation, which is typified by increased production of crevicular fluid and bleeding from the gingival sulcus. (13) Bleeding is an easily detectable objective symptom in the clinical setting. It is very valuable to dentists as it aids in the early diagnosis of gingival inflammation. (11, 13)

In order to eliminate the possibility of any kind of influence on the results obtained when registering the Gingival Bleeding Index "Ainamo and Bay" - no smokers were included in the study. This is because tobacco smoke causes gingival vasoconstriction in smokers. Despite a significant degree of inflammation in the periodontal tissues, there is evidence that smokers have decreased blood flow via the gingival capillaries. (18) Nicotine causes vasoconstriction and hinders the healing process following periodontal therapy. It's clear that gingival bleeding increases after quitting smoking because several research have shown that there is an increase in gingival blood flow after three days. (19, 20)

Inappropriate toothbrushing practices, neglecting to do interdental cleaning, and sporadic dental appointments are the main causes of dental plaque and calculus buildup. Gingival irritation is a predictable consequence of this buildup. One important risk factor for the deterioration of periodontal attachment is persistent gingivitis. (17) Because of the significant number of false-positive results, bleeding on probing has low sensitivity as a predictor of the advancement of periodontal disease, but it has excellent specificity because the absence of bleeding signifies health. (13, 14)

The present study set out to investigate whether a correlation exists between the two indices named above. A close correlation was found between the O'Leary and Ainamo and Bay index systems. This confirms the fundamental role of bacterial plaque in activating inflammatory processes in the gingiva. A similar study was published in 2018, but the participants were children aged 6 years. The correlation of two other index systems, the Greene and Vermillion Oral-Hygiene Index and the Papilla Bleeding Index, was examined. The authors found - similar to the present study - a close correlation between the plaque and gingival index. (21)

Furthermore, the present study highlighted the importance of motivational interviewing as the results at 6-8 weeks after completion of the hygiene phase in each of the patients included were impressive. These results are consistent with a 2018 study (22) and demonstrate the fundamental importance of an individualized approach in motivating and educating patients to maintain better personal oral hygiene.

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## Conclusion

The results demonstrate a significant improvement in the performance of the two indices. The close correlation available between the two indices is noticeable. In conclusion, patient motivation and education during the Hygiene Phase are of utmost importance, as improved personal oral hygiene of the patient inevitably affects the Plaque Index scores, which also reflect on the Gingival Index scores, closely related to periodontal health.

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