Gingival Index in Orthodontic Retention: Chain, Twisted and Flat Retainer Designs

Abstract

Background: Periodontal diseases remain a major public health problem worldwide. Clinical indices are critical tools for assessing gingival inflammation, plaque accumulation, and periodontal tissue breakdown. Among them, the Gingival Index (GI), introduced by Löe and Silness in 1963, is one of the most widely used parameters in both clinical and research settings.

Objective: This narrative review evaluates the clinical applications, strengths, and limitations of the Gingival Index, exploring its role in periodontal and orthodontic research and examining modern adaptations.

Methods: A structured literature search was conducted using PubMed, Scopus, and Web of Science (1963–2025). Randomised controlled trials (RCTs), clinical cohort studies, and in vitro investigations that used GI as an outcome measure were included. Emphasis was placed on studies investigating gingival inflammation during orthodontic retention, periodontal therapy, and comparative analyses with other indices.

Results: GI has been employed in thousands of clinical studies across periodontology and orthodontics. It remains a reliable, simple, and reproducible method for assessing gingival health, but examiner variability and subjectivity can limit consistency. Orthodontic studies, such as Ferreira et al. (2019) demonstrated that chain-like retainer designs produce higher GI scores than flat designs, reflecting plaque-retentive morphologies. Similarly, twisted multistrand stainless steel designs, which present increased surface roughness and inter-strand niches, have been associated with higher plaque accumulation and gingival inflammation in multiple longitudinal studies (Zachrisson, 1995; Dahl, 1991). Periodontal therapy trials consistently show significant GI reductions following scaling, root planing, and adjunctive antimicrobial therapies. Recent advances include digital probing and automated image analysis, which may improve reproducibility.

Conclusions: The Gingival Index continues to provide valuable insights into periodontal health. Despite its subjectivity, it remains indispensable in both clinical trials and practice.

Future directions should focus on integrating GI with objective digital technologies and combining it with indices such as Plaque Index and Bleeding on Probing for comprehensive periodontal evaluation.

Introduction

Periodontal disease is one of the most prevalent chronic inflammatory conditions worldwide, affecting approximately 50% of adults, with severe periodontitis impacting around 10% of the global population (Chapple et al., 2018; Kassebaum et al., 2014). Early diagnosis and monitoring are essential for preventing irreversible tissue breakdown, tooth mobility, and eventual tooth loss. Clinical indices play a vital role in quantifying gingival health, disease severity, and treatment outcomes.

The Gingival Index (GI), developed by Löe and Silness in 1963, has become one of the most widely applied clinical parameters for evaluating gingival inflammation. It uses a four-point scale (0–3) to score gingival health around each tooth. GI is simple, rapid, and reproducible when examiners are calibrated. It has been used in studies ranging from epidemiological surveys to clinical trials of periodontal therapies, orthodontic retention protocols, and biomaterial testing (Silness & Löe, 1964; Löe, 1967).

Despite its broad use, GI has been criticised for its subjectivity and inter-examiner variability. Unlike bleeding indices, GI relies partly on visual assessment of colour and texture, which can differ between clinicians. Moreover, GI does not directly measure plaque levels or attachment loss, limiting its scope (Ainamo & Bay, 1975). Nevertheless, GI remains a cornerstone in periodontal assessment and is still recommended in numerous guidelines (Chapple et al., 2018).

This review provides an updated evaluation of GI, discussing its historical development, methodological strengths and weaknesses, clinical applications in periodontology and orthodontics, and potential future directions incorporating digital technology.

Methods

A narrative review methodology was adopted. The electronic databases PubMed, Scopus, and Web of Science were searched from 1963 to July 2025. Search terms included 'gingival index,' 'Löe and Silness,' 'periodontal indices,' 'orthodontic retainers and gingival health,' 'periodontal therapy outcomes,' and 'plaque and gingival inflammation.'

Inclusion criteria:
1. Studies using the Gingival Index (GI) as a primary or secondary outcome.
2. Randomised controlled trials, cohort studies, cross-sectional epidemiological studies, case series, and in vitro models simulating gingival inflammation.
3. Articles published in English.

Exclusion criteria:
1. Non-English studies without translation.
2. Case reports without GI data.
3. Animal studies.

Data were synthesised thematically, focusing on GI's clinical relevance in periodontal therapy, orthodontic retention, and comparisons with other indices such as the Plaque Index (Silness & Löe, 1964), Bleeding Index (Ainamo & Bay, 1975), and Periodontal Screening Index.

Results

Clinical trials consistently show that passive fit, not material strength, determines long-term outcomes. Numerous clinical trials have used GI as an outcome measure to assess treatment efficacy.

Scaling and root planing consistently reduces GI scores by 30–60% within three months (Van der Weijden & Timmerman, 2002). Adjunctive chlorhexidine mouthrinse leads to further reductions in GI compared to mechanical therapy alone (Addy, 2000). Antibiotic gels such as doxycycline or minocycline show significant GI improvements in localised periodontitis (Heitz-Mayfield & Lang, 2013). Laser-assisted periodontal therapy has also been evaluated using GI, often demonstrating modest improvements (Aoki et al., 2015).

GI has also been widely used in orthodontic trials to assess the impact of appliances on gingival health. Fixed multibracket appliances increase GI scores due to plaque retention (Lundström & Hamp, 1980). Retention devices differ in their gingival impact. Ferreira et al. (2019) showed that chain-like Ortho-FlexTech retainers yielded higher GI scores compared to flat stainless-steel wires, highlighting design-related plaque retention. A systematic review by Littlewood et al. (2016) confirmed that retainers contribute to higher GI and plaque indices, emphasising the need for oral hygiene instruction during retention.

Large-scale surveys, such as the National Health and Nutrition Examination Survey (NHANES), have incorporated GI in evaluating gingival health trends (Eke et al., 2012).

These studies confirm the high prevalence of gingival inflammation, often underestimated when only probing depths are recorded.

Comparative studies reveal that GI correlates strongly with Plaque Index (Silness & Löe, 1964). Bleeding on probing (Ainamo & Bay, 1975) is more objective but less sensitive to subtle inflammation. Digital indices, including automated colour analysis of gingiva, show promise as adjuncts to GI (Schwendicke et al., 2020).

Discussion

The Gingival Index has stood the test of time as one of the most widely used indices in periodontology. Its popularity stems from its simplicity, reproducibility, and clinical relevance. Unlike probing depth or attachment loss, GI provides a non-invasive measure of early inflammation, making it particularly useful in longitudinal studies and orthodontic trials where invasive measurements are less practical.

However, GI's limitations must be acknowledged. The reliance on subjective colour and texture assessments introduces inter-examiner variability. Bleeding upon probing is more objective but may miss subclinical inflammation (Lang et al., 1990). Combining GI with Plaque Index and bleeding indices improves accuracy.

In orthodontics, GI is essential for monitoring gingival health during retention. Studies consistently demonstrate higher GI scores around retainers, particularly designs with increased plaque retention areas (Ferreira et al., 2019). These findings highlight the importance of design optimisation, patient hygiene education, and adjunctive professional cleaning.

Recent advances in digital dentistry are poised to modernise GI assessment. Colourimetric imaging, intraoral scanning, and AI-based analysis may provide more objective and reproducible scoring. Pilot studies have shown strong agreement between automated image-based scoring and clinical GI assessments (Schwendicke et al., 2020). Future research should focus on integrating these tools into clinical workflows.

From a public health perspective, GI remains valuable for epidemiology. It is cost-effective and feasible in large population surveys. However, calibration of examiners is crucial to ensure reliability.

Chain-like retainers such as Ortho-FlexTech have been shown to increase GI scores due to their plaque-retentive morphology (Ferreira et al., 2019). Similarly, twisted multistrand stainless steel designs, which present increased surface roughness and inter-strand niches,

have been associated with higher plaque accumulation and gingival inflammation in multiple longitudinal studies (Zachrisson, 1995; Dahl, 1991). Thus, both chain-like and twisted designs share common periodontal limitations compared with flat or CAD/CAM retainers, although the mechanisms differ: chain-like retainers create larger macroscopic niches, whereas twisted retainers present microscopic roughness and bacterial wicking potential.

Conclusion

The Gingival Index, introduced over 60 years ago, remains a cornerstone of periodontal assessment. Despite limitations in subjectivity and inter-examiner variability, it continues to provide valuable insights into gingival health, both in clinical practice and research. Its use in periodontal therapy trials, orthodontic studies, and epidemiological surveys highlights its versatility.

Future directions should aim at combining GI with objective digital technologies and supplementary indices to enhance reproducibility. The Gingival Index will likely remain central to periodontal research, but in an updated, technology-assisted form.

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