

DETERMINANTS OF DELAYED DENTAL CARIES TREATMENT IN CONSERVATIVE DENTISTRY

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Abstract

Dental caries is a frequent concern in conservative dentistry because untreated lesions can progress from early enamel or dentin involvement to pulpal disease and extensive tooth structure loss. In many adult patients, dental care is postponed until pain, visible cavitation, or functional discomfort appears, limiting the opportunity for minimally invasive treatment. This review aims to analyze the determinants of delayed dental caries treatment in conservative dentistry. A literature review was conducted using peer-reviewed journal articles published between 2017 and 2026 from PubMed, ScienceDirect, Google Scholar, Garuda, BMC Oral Health, MDPI, PLOS ONE, and other open-access databases. The reviewed literature focused on dental caries, delayed treatment, oral health literacy, dental anxiety, perceived need for care, socioeconomic barriers, and access to dental services. The findings indicate that delayed treatment is commonly associated with limited understanding of caries progression, fear of dental procedures, low perceived urgency, treatment costs, and barriers to dental service utilization. These determinants may increase the risk of advanced carious lesions and reduce the effectiveness of conservative dental management. Early diagnosis, patient-centered education, and better access to conservative dental care are needed to support timely treatment and preserve natural tooth structure.

Keywords: Dental Caries, Delayed Treatment, Conservative Dentistry, Oral Health Literacy, Dental Anxiety

Introduction

Dental caries remains one of the most common clinical problems seen in conservative dentistry. In adult patients, carious lesions may progress slowly and remain unnoticed until discomfort, food impaction, visible cavitation, or disturbance occurs. This often causes patients to delay dental visits and seek care only when the lesion has advanced. When treatment is delayed, the chance to manage caries through preventive, non-invasive, or simple restorative approaches becomes more limited. The disease may progress into deeper dentin, pulpal inflammation, pulpal necrosis, or periapical infection. This can require more complex procedures, such as root canal treatment, extraction, or prosthetic rehabilitation.

Conservative dentistry emphasises preserving natural tooth structure, maintaining pulp vitality, and restoring function through timely, appropriate treatment. Modern caries management now focuses on minimal intervention, risk assessment, early diagnosis, remineralisation, and selective removal of

carious tissue. Banerjee et al. note that caries management should control disease activity, preserve hard tissues, maintain pulp sensibility, and retain functional teeth in the long term ^[1]. Schwendicke et al. state that intervention decisions should consider lesion activity, cavitation, and cleansability, highlighting the need for early, accurate treatment decisions in conservative dental care ^[2]. Thus, delayed caries treatment can reduce options for tooth-preserving management and increase the need for invasive procedures.

The burden of dental caries extends beyond tooth loss. Oral diseases, including dental caries, are major global health challenges and linked to pain, impaired function, lower quality of life, and economic costs ^[3]. Listl et al. found that dental diseases incur substantial direct and indirect costs, including treatment expenditures and productivity losses ^[4]. In adults, untreated caries may impair chewing, speech, appearance, work performance, and comfort. These effects show that delayed treatment is not only a clinical concern but also impacts wider aspects of patient well-being and dental service use.

Several studies have shown that oral health literacy is closely related to oral health status and dental care behaviour. Baskaradoss reported that individuals with lower oral health literacy tend to have poorer oral health status, suggesting that the ability to obtain, understand, and use oral health information may influence treatment-seeking behaviour ^[5]. Limited oral health literacy may cause patients to underestimate early caries lesions, misunderstand the progressive nature of the disease, or believe that dental treatment is only necessary when pain is present. In conservative dentistry, this perception is problematic because early intervention is often less invasive and more effective at preserving tooth structure than treatment performed after extensive tissue destruction.

Delayed dental care is also influenced by behavioural and psychological factors. Steinvik et al. described delay in seeking dental care as a relevant issue in dental public health and showed that procrastination, dental attendance patterns, and self-efficacy may contribute to postponed dental visits ^[6]. Dental anxiety is another factor that may discourage patients from receiving timely care. Winkler et al. found that dental anxiety was associated with dental care routines and oral health-related quality of life in adults ^[7]. Patients with dental anxiety may avoid dental treatment because of fear of pain, previous unpleasant experiences, embarrassment, or concern about invasive procedures. This avoidance can create a cycle in which delayed attendance leads to more advanced caries, and advanced caries requires more complex treatment, which may further strengthen fear toward dental care.

Socioeconomic and service-related barriers also play an important role in delayed dental caries treatment. Treatment costs, insurance coverage, distance to facilities, limited appointment availability, and uneven service distribution may prevent patients from receiving timely care. Uguru et al. reported that access to oral care depends on availability, workforce, cost, and health system capacity ^[8]. Northridge et al. highlighted that oral health care disparities are tied to income, insurance, location, and vulnerability ^[9]. These barriers may make patients wait until pain is severe or emergency treatment is needed. Early conservative treatment may then become complex and less predictable.

Health promotion and patient-centred communication are needed to reduce delays in dental caries treatment. Hannan et al. emphasised that oral health inequities are related not only to access to care, but also to knowledge and behaviour ^[10]. In clinical practice, dentists should communicate about caries progression, treatment options, and the benefits of early intervention in a language that patients can understand. Patients need to recognise that the absence of pain does not always indicate the absence of disease. Early diagnosis and timely conservative treatment can reduce the risk of pulpal involvement, preserve remaining tooth structure, and prevent unnecessary invasive procedures.

Although many studies have discussed dental caries, minimally invasive management, dental anxiety, oral health literacy, and access to care, these topics are often addressed separately. Most publications emphasise clinical techniques, restorative materials, biological mechanisms, or overall oral health behaviour. There is limited synthesis linking delayed dental caries treatment with conservative dentistry or showing how patient, psychological, socioeconomic, and service-related factors affect

treatment timing. This gap matters because conservative dental care succeeds only if patients seek treatment before lesions advance, not just through clinical procedures.

Therefore, this review aims to analyse the determinants of delayed dental caries treatment in conservative dentistry. The discussion focuses on oral health literacy, dental anxiety, perceived need for care, socioeconomic barriers, access to dental services, and their implications for early diagnosis, minimally invasive care, and preservation of natural tooth structure.

Method

This study utilised a literature review design to analyse the determinants of delayed dental caries treatment in conservative dentistry. The population of interest included scientific articles discussing dental caries, delayed dental treatment, conservative dental care, oral health literacy, dental anxiety, perceived need for care, socioeconomic barriers, and access to dental services. Articles published between 2017 and 2026 were searched through PubMed, ScienceDirect, Google Scholar, Garuda, BMC Oral Health, MDPI, PLOS ONE, and other open-access journal databases. The keywords used in the search process included “dental caries,” “delayed dental treatment,” “delayed dental care,” “conservative dentistry,” “restorative dental care,” “oral health literacy,” “dental anxiety,” and “access to dental care.” The inclusion criteria were peer-reviewed journal articles written in English, available in full text, focused on adult populations, and relevant to clinical, behavioural, psychological, socioeconomic, or service-related factors associated with delayed dental caries treatment. Articles focusing only on children, laboratory-based restorative materials, non-journal publications, and studies unrelated to treatment delay were excluded. The selected articles were reviewed descriptively and analysed through thematic synthesis to identify key determinants affecting timely conservative dental management.

Oral Health Literacy and Delayed Dental Caries Treatment

Oral health literacy is an important determinant of whether adult patients seek dental caries treatment at an early stage or postpone care until symptoms become more severe. In conservative dentistry, patients need to understand that dental caries is a progressive disease and that early lesions may often be managed through preventive, non-invasive, micro-invasive, or minimally invasive procedures. However, patients with limited oral health literacy may not recognise the clinical significance of early caries, especially when pain is absent. This may lead to delayed treatment and greater loss of tooth structure over time ^[11,12].

Limited oral health literacy may also affect the patient’s ability to understand dental information, treatment options, and prognosis. Patients may assume that treatment is only necessary when there is pain, swelling, visible cavitation, or difficulty chewing. This perception is not always consistent with the clinical nature of caries progression, because early enamel and dentin lesions may develop without obvious symptoms. When treatment is postponed, the opportunity to preserve tooth structure and maintain pulp vitality becomes more limited ^[11,13].

In clinical practice, low oral health literacy can influence decision-making, treatment acceptance, and compliance with preventive advice. Patients who do not fully understand the consequences of untreated caries may delay restorative care, ignore recall visits, or rely on temporary pain relief. Therefore, dentists should communicate the diagnosis and treatment plan using clear, patient-centred language. Improving oral health literacy is essential to support timely conservative treatment, reduce disease progression, and preserve natural teeth ^[12,14].

Dental Anxiety and Treatment Avoidance

Dental anxiety is another factor that may contribute to delayed dental caries treatment. Patients who experience fear of dental procedures may avoid dental visits even when they are aware of oral symptoms. This anxiety may be related to previous unpleasant experiences, fear of pain, fear of local anaesthesia, embarrassment about oral conditions, or concern about complex treatment. As a result, patients may delay care until the lesion has progressed to a more advanced clinical stage ^[15,16].

From the perspective of conservative dentistry, dental anxiety may reduce the possibility of early and minimally invasive management. A carious lesion that could have been treated with preventive care or a simple restoration may progress to pulpal inflammation, pulpal necrosis, or periapical involvement when care is delayed. This progression can increase the need for endodontic treatment, extraction, or indirect restoration. Thus, dental anxiety is not only a psychological barrier, but also a clinical factor that may affect prognosis and treatment complexity ^[15,16].

Managing dental anxiety requires patient-centred communication and a supportive clinical approach. Dentists should provide clear explanations, ensure adequate pain control, and build trust before starting treatment. When patients understand that early caries treatment is usually simpler, less invasive, and more comfortable than delayed treatment, they may be more willing to seek care earlier. This approach supports the principles of conservative dentistry by reducing avoidance behaviour and improving the chance of tooth preservation ^[17,18].

Perceived Need for Dental Care

Perceived need for dental care refers to how patients judge whether their oral condition requires professional treatment. In many adult patients, dental visits are still driven by symptoms, particularly pain, visible tooth damage, food impaction, or difficulty chewing. This symptom-based approach may delay the management of dental caries, as early lesions often develop silently. As a result, the clinical need identified by dentists may not always match the patient's perceived need for treatment ^[19,20].

This mismatch is important in conservative dentistry. From the clinician's perspective, early diagnosis allows disease control, remineralisation, and preservation of tooth structure. From the patient's perspective, treatment may seem unnecessary if the tooth is still comfortable. This can lead to postponed visits, incomplete treatment plans, or self-medication with analgesics. Although pain relievers may provide temporary comfort, they do not eliminate the carious lesion or prevent further progression ^[13,19].

Improving perceived need requires effective education during dental visits and through broader oral health promotion. Patients should be informed that the absence of pain does not always indicate the absence of disease. Early conservative treatment can prevent further hard tissue destruction, reduce the risk of pulpal involvement, and maintain oral function. This message is important to encourage timely care and reduce the number of patients who seek treatment only when the condition has become advanced ^[14,20].

Socioeconomic Barriers to Conservative Dental Care

Socioeconomic barriers may also influence delayed dental caries treatment. Treatment cost, limited insurance coverage, unstable income, work obligations, and competing daily needs may cause patients to postpone dental visits. For some adults, dental care is considered less urgent than other household needs, especially when symptoms are still mild. This situation may increase the risk of untreated caries and reduce access to timely conservative dental management ^[21,22].

Financial barriers can affect the type and timing of treatment patients select. When patients delay care because of cost, a lesion that initially requires simple restoration may later require endodontic treatment, crown restoration, or extraction. This progression can increase overall care costs and reduce

the predictability of treatment outcomes. Therefore, delayed treatment may create a cycle in which financial limitations delay care, and delayed care leads to more expensive, complex treatment ^[21,23].

Socioeconomic inequality in dental care should be considered when planning preventive and conservative dental services. Affordable care, early screening, patient education, and accessible restorative treatment may help reduce the burden of advanced caries. In conservative dentistry, timely intervention is clinically important, but it must also be supported by service systems that allow patients to obtain care before the disease becomes severe ^[24,25].

Access to Dental Service

Access to dental services is closely related to the timing of dental caries treatment. Patients may delay care when dental facilities are difficult to reach, appointments are limited, service costs are high, or dental providers are not evenly distributed. In some settings, patients may only visit dental clinics when pain becomes severe or when emergency treatment is needed. This pattern may reduce the opportunity for early conservative management ^[24,25].

Limited access to dental services can affect both diagnosis and treatment. Without regular dental visits, early carious lesions may remain undetected until they become cavitated or symptomatic. This delay can shift treatment from preventive or minimally invasive care to more complex procedures. In conservative dentistry, early access is essential because treatment success often depends on lesion depth, remaining tooth structure, pulpal status, and restorability ^[13,25].

Improving access to conservative dental care requires attention to service availability, affordability, and continuity of care. Dental services should not only address emergency pain but also support early diagnosis, caries risk assessment, preventive interventions, and timely restorations. Better access can help patients receive treatment before extensive tooth structure loss occurs, thereby supporting the main goal of conservative dentistry: preserving natural teeth for as long as possible ^[23,25].

Health Promotion and Early Conservative Dental Care

Health promotion plays an important role in reducing delayed dental caries treatment, as many adults seek dental care only after pain or functional impairment occurs. In conservative dentistry, health promotion should not only emphasise oral hygiene practices, but also explain the progressive nature of dental caries, the importance of early diagnosis, and the benefits of timely conservative intervention. Educational strategies that improve patient awareness may help adults understand that early treatment can prevent further tooth structure loss and reduce the need for invasive procedures ^[26,27].

Oral health education should be understandable, practical, and relevant to patients' needs. Messages that are too technical may not be effective for patients with limited oral health literacy. Therefore, dentists and oral health educators should use simple explanations, visual aids, and patient-centred communication to describe caries progression and treatment options. This approach may strengthen patient understanding and encourage earlier attendance before carious lesions become symptomatic or extensive ^[26,28].

Early conservative dental care is consistent with the principles of minimal intervention dentistry. This approach emphasises early caries detection, caries risk assessment, remineralisation, preventive care, selective caries removal, and preservation of sound tooth structure. When patients delay treatment, the clinical window for non-invasive or minimally invasive management becomes narrower. Therefore, health promotion should support the clinical goal of conservative dentistry by encouraging patients to seek care before the lesion reaches an advanced stage ^[27,29].

Implications for Conservative Dental Management

Delayed dental caries treatment has direct implications for diagnosis, treatment planning, and prognosis in conservative dentistry. Early lesions may often be managed through preventive counselling, fluoride therapy, sealants, resin infiltration, or minimally invasive restorative procedures. However, when patients present with deep dentin caries, pulpal symptoms, or periapical involvement, the treatment plan becomes more complex and may require endodontic treatment or extraction. This condition shows that the timing of patient attendance can influence the extent of tooth preservation [29,30].

Preserving natural tooth structure should remain a central goal in conservative dental management. Contemporary caries care supports a biological and minimally invasive approach rather than unnecessary removal of dental hard tissue. This means that clinical decisions should consider lesion depth, lesion activity, pulpal status, restorability, patient risk factors, and patient preferences. When treatment is delayed, clinicians may have fewer conservative options, especially when the remaining tooth structure is insufficient or pulpal disease has progressed [27,30].

Patient-reported outcomes should also be considered in conservative dental care. Delayed treatment may increase pain, anxiety, treatment duration, and discomfort, while minimally invasive approaches may provide more acceptable clinical experiences for patients. A review on minimal intervention dentistry reported that this approach can be comparable to traditional or non-invasive modalities in patient-centred outcomes, including pain, anxiety, and treatment duration. These findings support the importance of early conservative management, especially for patients who avoid dental visits due to fear or prior unpleasant experiences [30,31].

Synthesis of Determinants

The determinants of delayed dental caries treatment are interconnected and should not be viewed separately. Oral health literacy influences how patients understand caries progression, while dental anxiety affects their willingness to attend dental appointments. Socioeconomic barriers and limited access to dental services may further delay treatment, even when patients recognise the need for care. These factors may interact and create a pattern in which dental visits occur only after pain, infection, or functional disturbance appears [16,21,24].

In conservative dentistry, this pattern is clinically important because delayed treatment may reduce the likelihood of preserving tooth structure and pulp vitality. Early lesions that could have been managed with preventive or minimally invasive care may progress into deep caries, irreversible pulpal disease, or periapical infection. As the lesion advances, the treatment becomes more invasive, more expensive, and less predictable. Therefore, delayed treatment should be understood as both a patient-related issue and a clinical challenge in conservative dental practice [27,29,30].

A comprehensive approach is needed to reduce delayed dental caries treatment. Dentists should strengthen patient education, identify anxiety and avoidance behaviour, explain the benefits of early care, and provide clear treatment options. At the same time, dental services should improve accessibility, affordability, and continuity of care. These strategies may help patients receive conservative treatment earlier, prevent advanced caries, and support the long-term preservation of natural teeth [25,26,31].

Discussion

The findings of this review indicate that delayed dental caries treatment is influenced by several interconnected determinants, including oral health literacy, dental anxiety, perceived need for care, socioeconomic barriers, access to dental services, and the effectiveness of oral health promotion. These determinants show that delay in caries treatment cannot be explained solely by the tooth's clinical condition. In conservative dentistry, the timing of patient attendance is highly relevant, as early carious lesions may still be managed with preventive, non-invasive, or minimally invasive procedures, whereas advanced lesions often require more complex treatment. This finding is in line with the contemporary concept of conservative caries management, which emphasises early diagnosis, caries control, selective intervention, and preservation of natural tooth structure ^[1,2,27,29].

Oral health literacy appears to be one of the most important factors in determining whether patients understand the need for early dental treatment. Patients with limited oral health literacy may not recognise that caries can progress without pain, especially in the early stage. This may explain why many adults visit dentists only when pain, cavitation, or functional discomfort has already developed. Previous studies have shown that oral health literacy is associated with oral health status, dental service utilisation, and oral health-related behaviour ^[5,11,12]. In conservative dentistry, this issue is clinically significant because the failure to recognise early disease may reduce the opportunity for remineralisation, preventive care, or simple restorative treatment.

Dental anxiety also contributes to delayed treatment by encouraging avoidance behaviour. Patients who fear dental procedures may postpone dental visits even when they are aware of symptoms. This avoidance may worsen the clinical condition, as untreated caries can progress to deeper dentin involvement, pulpal inflammation, or periapical infection. The literature indicates that dental anxiety is associated with dental attendance patterns and oral health-related quality of life ^[7,15,16]. Therefore, dental anxiety should not be viewed only as an emotional response, but also as a barrier that may influence treatment complexity and prognosis in conservative dental practice.

The perceived need for dental care also plays an important role in delayed treatment. Many patients still consider dental care necessary only when pain is present. This perception creates a gap between clinical need and patient-perceived need. From a clinical perspective, early intervention may prevent further tissue destruction and preserve pulp vitality. From the patient's perspective, however, treatment may seem unnecessary when the tooth is still comfortable. This mismatch may lead to postponed care, self-medication, or incomplete treatment planning. Previous research has shown that dental service use is influenced by perceived oral health condition, urgency, symptoms, and the impact on quality of life ^[19,20].

Socioeconomic and access-related barriers further complicate the problem. Treatment cost, limited insurance coverage, distance to dental facilities, appointment availability, and competing daily responsibilities may prevent adults from receiving timely conservative dental care. These barriers may cause patients to seek care only when symptoms become severe or emergency treatment is needed. Studies on dental care access have shown that oral health disparities are closely related to income, service availability, health system capacity, and broader social determinants ^[8,9,20,21]. In conservative dentistry, these barriers may shift treatment needs from simple restorative care to endodontic treatment, extraction, or prosthetic rehabilitation.

Health promotion has an essential role in reducing delayed dental caries treatment. However, health promotion should not only focus on brushing frequency or dietary advice. It should also explain the progressive nature of caries, the importance of early diagnosis, and the benefits of conservative treatment before symptoms become severe. Patient education must be clear, practical, and appropriate to the patient's level of understanding. Previous studies have emphasised the value of oral health education and minimally invasive dentistry in supporting prevention, early detection, and patient-

centred care ^[26,28,30]. This approach may help patients understand that early treatment is usually less invasive, less costly, and more effective in preserving tooth structure.

The synthesis of these findings suggests that delayed dental caries treatment is a multifactorial issue with direct implications for conservative dentistry. Patient-related factors, such as literacy, anxiety, and perceived need, interact with service-related factors, such as cost, accessibility, and continuity of care. When these factors are not addressed, patients may enter the dental care system later in the disease process. At that point, the treatment plan may become more invasive and less aligned with the principles of minimal intervention. Therefore, conservative dental care should be supported not only by clinical skill and restorative techniques, but also by communication, prevention, behavioural understanding, and accessible service delivery ^[25,27,29,31].

Overall, delayed dental caries treatment should be understood as a challenge that connects clinical dentistry with patient behaviour and service utilisation. For conservative dentistry, the main implication is clear: the earlier the patient seeks care, the greater the possibility of preserving natural tooth structure and maintaining pulp vitality. Dentists should identify patients at risk of delaying care, provide individualised education, reduce fear through empathetic communication, and emphasise the benefits of early conservative management. These strategies may help reduce advanced caries cases and support the long-term retention of natural teeth ^[1,2,30,31].

Conclusion

Delayed dental caries treatment in conservative dentistry is influenced by several interrelated determinants, including oral health literacy, dental anxiety, perceived need for care, socioeconomic barriers, access to dental services, and the effectiveness of oral health promotion. These factors may cause adult patients to postpone dental visits until pain, visible cavitation, food impaction, or functional disturbance occurs. Such delay may reduce the opportunity for preventive, non-invasive, micro-invasive, or minimally invasive treatment and may increase the need for more complex procedures, including endodontic treatment, extraction, or prosthetic rehabilitation. From a conservative dental perspective, timely treatment is essential because the preservation of natural tooth structure and pulp vitality depends greatly on the stage at which the patient seeks care. Early diagnosis and intervention allow dentists to control disease progression, preserve remaining hard tissue, and provide more predictable, less invasive treatment. The findings of this review suggest that delayed treatment should not be understood solely as a clinical consequence of untreated caries, but also as a reflection of patients' knowledge, emotional responses, financial capacity, treatment perceptions, and service accessibility. Therefore, conservative dental management should be supported by clear patient education, empathetic communication, anxiety reduction, and improved access to early restorative and preventive care. Dentists need to explain that the absence of pain does not always indicate the absence of disease, and that early caries management can help prevent further destruction of tooth structure. Strengthening oral health literacy, encouraging routine dental examinations, and improving patient awareness of early conservative treatment may help reduce the number of advanced caries cases. In addition, dental services should be designed to support timely care, affordability, and continuity of treatment. A comprehensive approach that combines clinical conservative principles with patient-centred education and accessible dental care is necessary to minimise treatment delay and support the long-term preservation of natural teeth.

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