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Stainless Steel Crown As a Management Technique for Pediatric Dental Caries-An Updated Review for Dental Caries, Biochemical Aspects, and Management Techniques

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Abstract

Background: Pediatric dental caries are a common issue, particularly in young children, and require effective restorative solutions to preserve the function and structure of primary teeth. Stainless steel crowns (SSCs) are widely used for managing severe dental caries in primary teeth due to their superior durability, cost-effectiveness, and long-term performance. Although SSCs have been a cornerstone of pediatric restorative dentistry since their introduction in the mid-20th century, their adoption faces some hesitations among practitioners.

Aim: The purpose of this review is to evaluate the clinical effectiveness, indications, and contraindications for SSCs in pediatric dentistry while addressing common professional reservations regarding their use. The Review will focus on biochemical aspects of pediatric dental caries.

Methods: A comprehensive review of the literature on SSCs, including clinical studies, historical developments, and expert opinions, was conducted. The review focused on the advantages and challenges of using SSCs, including their durability, indications, contraindications, and procedural requirements.

Results: SSCs provide excellent protection and functional restoration for severely decayed primary teeth, particularly after pulp therapy or in high-risk caries patients. They are recommended for managing extensive decay, developmental anomalies, and other conditions where traditional restorative materials may fail. However, certain contraindications, such as advanced root resorption or patient cooperation issues, may limit their use. Despite their clear benefits, some practitioners remain cautious, citing perceived complexities in placement.

Conclusion: Stainless steel crowns remain a reliable and cost-effective solution in pediatric restorative dentistry. Their use addresses both clinical and economic concerns, offering long-term durability and reduced need for retreatment. Education and training to enhance familiarity with SSCs could help overcome professional reservations and improve their adoption.

Keywords: Stainless steel crowns, pediatric dentistry, dental caries, restorative solutions, caries management, crown placement.

1. Introduction

Dental caries is a widely prevalent condition, particularly among young children, where it poses significant challenges to oral health management [1]. The care of decayed primary teeth is vital due to their multifaceted role in facilitating chewing, articulation, and maintaining proper spacing for the permanent dentition. Effective management of pediatric dental caries is complicated by behavioral considerations and the necessity for durable restorative solutions that can endure until the natural exfoliation of primary teeth [2]. Among the various treatment modalities available, stainless steel crowns (SSCs) are the most frequently utilized option for restoring and preserving severely decayed or damaged primary teeth. These crowns, initially introduced into pediatric dentistry by Engel in 1947 and subsequently popularized by Humphrey in 1950, have become a cornerstone in restorative dentistry for children. For over half a century, SSCs have demonstrated superior durability and longevity compared to alternative materials like amalgam and composite. Their cost-effectiveness, reliability, and ability to provide interim full-coronal coverage remain unmatched by other restorative options [3][4]. Scientific evidence strongly supports the use of stainless steel crowns as the preferred restorative intervention for children with a high risk of caries. The efficacy of SSCs lies in their ability to withstand significant functional demands while maintaining structural integrity over extended periods [4]. Additionally, their placement is considered more straightforward than that of intracoronal restorations, such as amalgam or composite fillings. Despite these advantages, some dental professionals remain hesitant to adopt SSCs in clinical

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practice, citing perceived complexities in their application. However, such reservations are at odds with studies demonstrating their ease of placement and superior long-term outcomes when compared to alternative restorative techniques [5].

The use of SSCs in pediatric dentistry addresses both the clinical and economic aspects of dental care. From a clinical perspective, these crowns provide robust protection against further decay and structural deterioration. They are particularly advantageous in cases of extensive caries, where other materials might fail to provide adequate coverage or durability. Moreover, SSCs have been shown to reduce the need for retreatment, a critical factor in minimizing discomfort and inconvenience for young patients. Economically, the cost-effectiveness of SSCs is underscored by their longevity and the reduced likelihood of requiring replacement, making them an ideal choice in both private and public healthcare settings. Despite their proven benefits, the adoption of stainless steel crowns continues to face challenges, primarily stemming from professional biases and a lack of familiarity among some practitioners. Educational initiatives and training programs focusing on the proper application and long-term benefits of SSCs could bridge this gap, promoting their wider acceptance in pediatric dental practice. By integrating these crowns more broadly into clinical protocols, dental professionals can ensure improved outcomes for pediatric patients, particularly those at high risk for caries. In conclusion, stainless steel crowns represent a time-tested, reliable, and cost-effective solution for managing severe dental caries in children. Their unparalleled durability, coupled with their ability to protect and preserve primary teeth, underscores their significance in pediatric restorative dentistry. Addressing misconceptions and promoting evidence-based practices will be crucial in enhancing their utilization, ultimately benefiting young patients by ensuring optimal oral health and functionality.

Biochemistry of Pediatric Dental Caries:

Dental plaque serves as the environment where microbial metabolic activities occur, facilitating both harmful and beneficial processes that influence the progression of lesions. The primary sources of alkali production in plaque and saliva are urea, nitrate, and arginine. The ammonia produced during the metabolism of these substances plays a crucial role in inhibiting the acidogenic microbiota and the development of dental caries by neutralizing acids and maintaining oral microbiota stability. Consequently, ammonia levels, pH, and organic acids, such as lactate, can serve as potential biomarkers for the acidogenicity of oral communities and may correlate with the risk of developing carious lesions. However, it remains uncertain whether measuring these compounds in dental plaque or saliva provides superior diagnostic and predictive value. In 1940, Stephan observed that the pH of dental plaque decreases within 2 to 15 minutes after rinsing with a sugary solution, primarily due to lactic acid, before returning to baseline levels around 40 minutes. This pH recovery is facilitated by buffering mechanisms, including bicarbonate, urea, and arginine. Thus, not only is the basal pH a key indicator of acidogenic potential, but the pH level achieved after fermentation is also significant. In this study, both pH and lactate levels were measured before and after the pH drop induced by sugar exposure.

The ability of saliva and dental plaque to respond to acid stress serves as an indicator of how effectively the oral environment compensates for and balances acids, either through salivary buffering mechanisms or microbial action, such as that of *Streptococcus dentisani*. To date, no studies have concurrently examined the response to acid stress in both saliva and plaque, alongside levels of *Streptococcus mutans* and *S. dentisani*, and their association with clinical caries history and biochemical parameters in both saliva and plaque. Therefore, this study aims to simultaneously investigate clinical, biochemical, and microbiological factors potentially linked to caries in a sample of adults. The following variables were assessed: plaque and gingival indices; salivary flow; pH levels in saliva and plaque; and lactate levels in both saliva and plaque before and after sugar exposure. Additionally, the presence of *S. mutans* and *S. dentisani* in both plaque and saliva was quantified using quantitative PCR. The study also explored the relationships between these factors, dental caries experience, gender, and tooth-brushing frequency, in order to identify potential biomarkers and risk predictors of the disease.

Indications:

Stainless steel crowns (SSCs) serve as an essential restorative option in pediatric dentistry, particularly in cases requiring robust and durable solutions for primary teeth. Their use is indicated across a variety of clinical scenarios where traditional restorative materials may be insufficient. A primary indication for SSC placement arises following pulp therapy, as these crowns provide comprehensive coronal coverage, safeguarding the treated tooth from reinfection and structural compromise. Similarly, SSCs are ideal for managing multisurface caries, where extensive decay necessitates a restoration that offers both strength and long-term reliability [6].

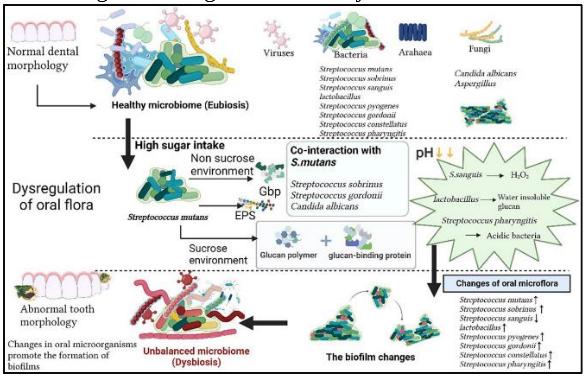

Figure 1: Dental Caries Development.

In addition to their role in treating dental caries, SSCs are particularly beneficial for patients identified as being at high risk for caries. These individuals, often characterized by recurrent decay or poor oral hygiene, require restorations capable of enduring adverse conditions. SSCs are also recommended for deciduous teeth affected by developmental anomalies, such as amelogenesis imperfecta, dentinogenesis imperfecta, and enamel hypoplasia. These conditions weaken the structural integrity of the teeth, making them susceptible to fractures and decay. By providing full coronal coverage, SSCs mitigate these risks, preserving function and aesthetics [6]. Further indications for SSCs include cases of teeth with extensive wear due to attrition or parafunctional habits. In such scenarios, traditional restorations may fail to provide the necessary durability, whereas SSCs excel in maintaining the tooth's structural integrity. Teeth with significant structural compromise, such as fractured teeth or those with proximal box preparations extending beyond anatomical line angles, also benefit from SSC placement. In these cases, the crowns act as a protective shell, restoring the tooth's functionality and preventing further damage [6].

SSCs are also invaluable as abutments for space maintainers, ensuring the stability of the dental arch and preventing complications associated with premature tooth loss. Their robust nature makes them particularly suitable for this purpose, as they can withstand the forces exerted by orthodontic appliances. Moreover, SSCs are recommended for patients who are unlikely to attend regular follow-up appointments. Given their exceptional durability and low maintenance requirements, these crowns offer a practical solution for ensuring long-term oral health in patients with limited access to routine dental care [7]. Overall, the indications for stainless steel crowns reflect their versatility and effectiveness in addressing a wide range of dental conditions in pediatric patients. Whether for managing the aftermath of pulp therapy, restoring extensively decayed or worn teeth, or addressing developmental defects, SSCs provide unparalleled benefits in terms of strength, durability, and reliability. By offering comprehensive coverage and reducing the likelihood of restoration failure, these crowns ensure optimal outcomes in even the most challenging clinical scenarios. Their utility in serving high-risk patients and acting as abutments for orthodontic appliances further underscores their significance in modern pediatric dentistry.

Contraindications:

While stainless steel crowns (SSCs) are widely recognized for their utility in pediatric dentistry, certain clinical scenarios contraindicate their use. Understanding these contraindications is essential to ensuring optimal patient care and preventing potential complications. One significant contraindication is when a primary tooth exhibits more than half of its root resorption. In such cases, the reduced structural integrity of the tooth renders it unsuitable for crown placement, as the remaining root may fail to provide adequate support for the restoration. Similarly, SSCs are contraindicated for primary teeth that are nearing natural exfoliation, typically within six to twelve months. Placing a crown on a tooth in this stage of its lifecycle is unwarranted, as the impending exfoliation would render the restoration redundant [8]. Another critical contraindication involves teeth exhibiting excessive mobility. Such mobility is often indicative of advanced root resorption or periodontal compromise, making the placement of an SSC impractical and potentially detrimental. Attempting to restore a mobile tooth with an SSC may exacerbate underlying issues and compromise adjacent teeth or oral structures. Furthermore, patient-specific factors, such as nickel allergies or sensitivities, must be considered. Given that SSCs contain nickel, their use in patients with known allergies can result in adverse reactions, including localized inflammation or systemic hypersensitivity responses. In such cases, alternative restorative materials that do not contain nickel should be explored to avoid compromising the patient’s health and comfort [8].

Patient cooperation is another critical factor influencing the suitability of SSC placement. The inability to achieve adequate cooperation, particularly in younger children or individuals with special needs, may make it challenging to fit the crown properly. This limitation often stems from the patient’s discomfort or anxiety during the procedure, which can lead to compromised outcomes. When patient cooperation cannot be ensured, clinicians may need to explore other restorative options or consider behavior management techniques to facilitate treatment [9]. In conclusion, while SSCs offer numerous advantages in managing pediatric dental conditions, their application is not universally appropriate. Contraindications such as significant root resorption, imminent tooth exfoliation, excessive tooth mobility, nickel allergies, and lack of patient cooperation must be carefully evaluated. Recognizing these factors enables clinicians to make informed decisions that prioritize patient safety and treatment efficacy. By considering these contraindications, dental professionals can better tailor their approaches to meet the unique needs and circumstances of each patient, thereby ensuring the best possible outcomes in pediatric dental care.

Equipment:

The successful placement of stainless steel crowns (SSCs) in pediatric dentistry relies on the appropriate selection and use of specialized equipment. Proper tools and materials ensure precision in crown preparation, placement, and finishing, ultimately contributing to favorable outcomes. The following outlines the necessary equipment and its specific applications in SSC procedures.

Burs and Stones:

Various dental burs are indispensable for SSC placement. The No. 169L or No. 69L F.G burs are frequently utilized for crown preparation, offering precision for initial contouring and shaping [10]. For the removal of carious tissue, round burs are preferred due to their effectiveness in excavating decayed material while minimizing damage to healthy tooth structures. When it comes to refining the crown preparation, flame-shaped diamond burs or round-end tapered burs are essential. These burs facilitate the creation of smooth margins and optimal crown fit. Long, thin tapered burs are particularly advantageous for fine adjustments in tight spaces, ensuring detailed and accurate preparations.

Additional Instruments and Materials:

In addition to burs, other tools play critical roles in the SSC process. Rough or whitening polishing wheels are employed to enhance the crown's surface finish, providing a smooth and esthetically pleasing appearance. For further refinement, greenstones, heatless stones, or rubber wheel stones are utilized to polish and finish the crown margins effectively [11]. Wire wheels are also used in finishing procedures, contributing to the precision of the final restoration. The cementing process requires a cement medium, which includes tools such as a glass slab or cement mixing pad, and a spatula for thorough and consistent mixing. These materials are essential for ensuring a durable and secure bond between the crown and the tooth structure.

Supportive Equipment:

Rubber dam armamentarium is vital for isolating the operative field, promoting a dry working area, and reducing contamination during the procedure. Local anesthesia is often necessary to ensure patient comfort, particularly during crown preparation. Dental floss is used for checking interproximal contacts and ensuring proper crown fit. Pliers and other instruments aid in adjusting the SSC to achieve an optimal fitness and adaptation to the tooth. A sharp dental explorer is another critical tool, employed for marking the gingival extension of the crown margin. This step is crucial for determining the precise margin placement and ensuring proper crown coverage, which protects the underlying tooth structure from recurrent decay. In summary, the placement of SSCs requires a comprehensive set of equipment designed for each stage of the procedure, from preparation to finishing. Each tool, from specialized burs to polishing stones and supportive materials like cement and dental floss, plays a unique role in achieving a durable and esthetically acceptable restoration. By utilizing these instruments effectively, clinicians can ensure high-quality outcomes and long-term success in pediatric restorative dentistry.

Preparations:

The preparation for placing stainless steel crowns (SSCs) involves meticulous planning and evaluation to ensure optimal fit and function. Before reducing the tooth surface or adapting the crown, specific preparatory steps must be followed to enhance clinical outcomes and ensure long-term restoration success.

Crown Selection:

The selection of an appropriate crown is a crucial step and can be performed through various methods. Measuring the mesiodistal dimension of the tooth before preparation offers a reliable reference for crown size. Alternatively, a trial-and-error approach may be employed, or the crown size can be determined after the tooth has been prepared. However, space loss distal to the mandibular primary first molar can lead to a reduction in the mesiodistal dimension, complicating crown selection. In such scenarios, measuring the dimension of the contralateral tooth is recommended as a guide [12]. A properly selected crown should fit securely, snapping into place during the try-in phase [13]. In addition to size, other factors must be considered during crown selection. The occlusal anatomy of the crown, the presence of primate spaces, and the height of the crown are critical elements that influence the fit and overall function of the restoration [6]. These considerations ensure that the crown adapts well to the patient’s dental arch, maintaining both functionality and esthetics.

Occlusal Evaluation

Prior to placing the rubber dam and initiating tooth preparation, a thorough occlusal evaluation is necessary. This includes observing for extrusion of the opposing tooth, which can occur due to long-standing carious lesions. The clinician should also assess for mesial drift resulting from proximal space loss caused by carious lesions, as these shifts can alter the occlusion and complicate crown adaptation.

Additional aspects to examine include spacing or crowding within the dental arch, which may impact crown placement. The occlusion should be evaluated directly in the patient’s mouth or indirectly through dental analysis casts. This step allows for a detailed assessment of incisor, canine, and molar relationships on both sides of the arch. Furthermore, the dental midline and cusp-fossa relationships should be examined bilaterally to ensure symmetry and proper occlusal alignment. By carefully selecting the appropriate crown and conducting a comprehensive occlusal evaluation, clinicians can address potential complications before they arise. This thorough preparatory phase is essential for achieving a successful restoration, minimizing the risk of misfit, and ensuring the SSC functions effectively within the dental arch. These steps collectively contribute to the durability, reliability, and patient satisfaction associated with SSC restorations.

Local Anesthesia

Effective local anesthesia is crucial to minimize discomfort during the preparation and placement of stainless steel crowns (SSCs). Anesthetizing the tooth and adjacent soft tissues ensures the patient experiences no pain during tooth reduction or any incidental soft tissue trauma that may occur during the trial fitting of the crown. In certain cases, additional anesthesia for the palatal surfaces of upper teeth is recommended to enhance patient comfort. Among the available methods, local infiltration anesthesia is preferred over topical applications due to its superior efficacy [14]. For root-treated teeth, the preparation process often involves reducing the mesial and distal contact areas, which can inadvertently cause trauma to the gingival tissues. In such instances, topical anesthesia can be applied to manage the discomfort effectively. While it may suffice in these specific scenarios, comprehensive anesthesia ensures better pain management during more invasive steps of the procedure.

Rubber Dam Isolation

The use of rubber dam isolation during SSC placement is strongly advised for multiple reasons. It serves to protect adjacent tissues from inadvertent trauma and provides an unobstructed field of view, which enhances the operator’s efficiency. Additionally, employing a rubber dam aids in behavior management for pediatric patients, creating a controlled environment and reducing potential anxiety. Importantly, it prevents the accidental ingestion or aspiration of the SSC, ensuring patient safety throughout the procedure.

Wedging

The application of wooden wedges prior to initiating tooth preparation is recommended by numerous experts in the field. These wedges help maintain separation between adjacent teeth, ensuring the preservation of the enamel surfaces and reducing the likelihood of iatrogenic damage. The strategic use of wedges also facilitates more precise tooth preparation by securing a stable working area, further minimizing complications.

Caries Removal

The removal of dental caries and the performance of pulpotomy procedures are integral steps that can be carried out either before or after crown preparation. However, in most clinical scenarios, significant portions of crown preparation are performed concurrently with caries excavation. This approach allows for efficient treatment planning and execution, ensuring that the tooth is adequately prepared for the placement of the SSC while addressing underlying carious lesions [6][8][15]. By employing a combination of effective local anesthesia, rubber dam isolation, strategic wedging, and systematic caries removal, clinicians can achieve a streamlined and patient-centered approach to SSC placement. These preparatory measures not only enhance clinical outcomes but also prioritize patient comfort and safety, particularly in pediatric dentistry, where behavioral and anatomical considerations play a critical role.

Technique or Treatment

Optimal preparation of the tooth surface is a critical step in the successful placement of stainless steel crowns (SSCs). Full et al. advocated for initiating the procedure with occlusal surface reduction, as this provides improved access to proximal areas [16]. In contrast, other researchers have suggested commencing with proximal slicing before addressing the occlusal surface [17]. A widely accepted strategy involves reducing the occlusal surface first, which facilitates simultaneous caries removal and proximal surface reduction. Performing proximal reduction initially may complicate the diagnosis of potential pulp exposure due to gingival bleeding that often occurs during proximal preparation.

Occlusal Reduction

The reduction of the occlusal surface should be performed using a 69L or 169L bur, ensuring that 1.5 to 2.0 mm of the surface is removed. This reduction must preserve the original contour of the cusps to maintain proper anatomy. Occlusal depth guidance grooves may be created to aid in achieving uniform reduction. In cases where significant occlusal surface loss has already occurred due to caries, the marginal ridges of adjacent teeth can serve as a reliable reference point [18].

Proximal Reduction

Proximal surface reduction involves the use of a 69L or tapered fissure bur at high speed to create adequate space for the crown. This process should establish a feather-edge finish line gingivally while taking care to avoid damaging neighboring teeth. The mesial and distal contact points must be cleared sufficiently to allow a probe to pass through them. Proximal slices should follow the natural contour, converging slightly toward the occlusal and lingual surfaces. The reduction must ensure a smooth taper from occlusal to gingival, free from ledges or shoulders, resulting in a clean and seamless preparation [10][6].

Buccal and Lingual Reduction

The buccal and lingual surfaces are addressed in the next step. Reduction in these areas is generally optional. Certain practitioners recommend creating a gingivally inclined long bevel on these walls to facilitate crown placement, while others suggest minimal reduction (0.5 to 1 mm) unless pronounced enamel convexities are present. In such cases, only a small amount of enamel should be removed to maintain the integrity of the tooth structure. Duggal and Curzon recommend trying the selected crown prior to performing buccal and lingual reduction, ensuring proper fit and alignment [12][13].

Final Adjustments and Caries Management

To complete the preparation, all line and point angles must be rounded. Angles at the occlusal-lingual and occlusal-buccal junctions should be beveled at a 45-degree angle. The bur should be aligned parallel to the tooth’s long axis, ensuring smooth transitions between surfaces. Any residual caries should be meticulously removed, and appropriate pulp therapy should be administered in cases of pulp involvement. The rubber dam remains in place throughout the preparation to protect the surrounding tissues and enhance visibility. However, if it interferes with the crown’s seating and adaptation, it may be removed after completing tooth preparation. This systematic approach ensures the optimal fit and long-term success of the SSC [6].

Crown Adaptation

Proper crown adaptation is essential for ensuring retention and protecting gingival health. Poorly adapted crowns can harbor plaque and bacteria, leading to gingivitis and recurrent cervical caries. Spedding emphasized two fundamental principles for stainless steel crown adjustment: determining the correct occlusal-gingival crown length and contouring the crown margins circumferentially to align with the natural contours of the tooth's marginal gingiva. To achieve optimal adaptation, the crown is initially placed linguo-buccally on the prepared tooth. Gentle pressure is applied in the buccal direction, allowing the crown to slide over the buccal surface and into the gingival sulcus. Friction is expected as the crown passes over the buccal bulge; however, if positioning proves challenging due to excessive buccal bulge or a crown that is too small, a larger crown should be selected, or the buccal bulge should be reduced. Once the crown is seated, the patient is asked to bite down to evaluate the preliminary occlusal and marginal ridge relationships. A scratch or dotted line is marked on the crown at the free gingival margin, indicating the portion to be trimmed. Using crown and bridge scissors or a large abrasive wheel, operators remove approximately 1 mm below the scratch line for precise adaptation. This process is repeated until the crown extends 1 mm beneath the gingival margin. Circumferential contouring is accomplished with specialized pliers. The No. 137 pliers create a belling effect in the middle third of the crown, while Johnson contouring pliers with a No. 114 or curved beak pliers contour the cervical third and proximal areas. Finally, crimping pliers are used to crimp the cervical margin circumferentially, ensuring the crown margin conforms to the gingival margin. Radiographic verification is recommended to confirm proper gingival contour and complete tooth coverage [19][20][13][21].

Finishing

The finishing process involves creating a knife-edge margin at the cervical border of the crown using a large green stone. The bur is rotated counterclockwise at a 45-degree angle to refine the margin, followed by smoothing with a rubber wheel. For polishing, a cloth or chamois wheel is used on a dental lathe, employing a Tripoli polishing agent and jeweler’s rouge to achieve a smooth and polished surface [11].

Cementation

Securing the crown requires the use of a luting cement. After sitting the crown on the prepared tooth, it is held under pressure until the cement hardens. Glass ionomer, zinc polycarboxylate, and zinc phosphate cements are recommended, with fluoride-leaching cements such as resin-modified glass ionomer cement (RMGIC) offering additional clinical benefits. While research indicates that cement type minimally affects retention, proper crown contouring and crimping remain the primary determinants of retention [22]. Careful removal of excess cement is critical to maintain gingival health. This is typically achieved by running a pointed instrument along the crown's margins and using knotted dental floss to clean the contact areas. Residual cement has been associated with adverse gingival outcomes, underscoring the importance of thorough cleanup [8][6].

Modifications for Stainless Steel Crowns

When adjacent stainless steel crowns are required within the same quadrant, it is essential to prepare both teeth during a single visit to ensure proper fitting. The proximal surfaces should undergo slightly greater reduction than usual to facilitate the placement of multiple crowns. However, the occlusal reduction for each tooth must be completed individually. Attempting simultaneous reduction of both teeth often results in improper preparation. If proximal caries are present in adjacent teeth, mesiodistal space may be lost. In such cases, preparation modifications should enable the use of smaller crowns, focusing on reducing the buccal and lingual walls rather than the proximal areas to achieve a proper fit [6][10][23]. In situations where mesial drift or arch length loss has occurred, often due to caries, further adjustments are required. Reducing the mesiodistal dimensions of the crown becomes necessary. This can be achieved by flattening the mesial and distal contact areas with Adam's design pliers, which provides moderate dimension reduction. For cases involving mesial drift in the lower arch, a smaller contralateral upper tooth crown can be utilized. Another advanced modification involves vertical slicing and spot-welding an additional segment of stainless steel band material to the crown to increase its perimeter or length. However, the clinical efficacy of such modifications remains underexplored and warrants further evaluation [8].

Crown Placement Before the Eruption of Permanent Mandibular First Molar

When placing a crown before the eruption of the permanent mandibular first molar, accurate measurement of the mesiodistal dimension is critical. Meticulous proximal tooth reduction is necessary to prevent crown margin overhang. This precaution is particularly important as improper crown placement may encroach on the space required for the permanent molar's eruption, potentially distorting its eruption pathway. For example, overextension of the crown on a primary second molar may disrupt the alignment of the permanent first molar [see Image. Stainless Steel Crown in Primary Second Molar].

Managing Deep Subgingival Caries with Crown Extensions

Teeth with caries extending apically beyond the crown margin require special preparation to create a proper finishing line. In these cases, restorative material should be used to fill the carious areas prior to tooth preparation. Alternatively, a stainless steel extension can be soldered to the crown to form a flange, providing coverage for the affected area and ensuring stability [6].

Restoration for Bruxism and Hypoplastic Teeth

For patients with bruxism or hypoplastic teeth, significant occlusal wear often reduces vertical height. To address this, Croll's technique may be employed. This involves applying a solder layer to the crown's impression surface to enhance occlusal height and reduce the need for occlusal reduction. Aside from this specific intervention, the remaining steps in tooth preparation and crown adaptation remain consistent with standard procedures [24].

Open-Faced Stainless Steel Crowns

Aesthetic concerns can be addressed for anterior teeth by modifying stainless steel crowns into open-faced designs. The labial surface of the crown is trimmed, creating an open face that is later restored with composite resin for a more natural appearance. Alternatively, aesthetic crowns featuring prefabricated tooth-colored buccal and occlusal facings are available, offering an aesthetically appealing solution while maintaining the durability of stainless steel crowns [8].

Modification of Stainless Steel Crown Sizes

In cases where a stainless steel crown is undersized, the crown wall of the best-fitting crown can be altered by making a buccal or lingual cut. Following this, an additional segment of 0.004-inch orthodontic stainless steel band is welded over the gap. This piece is then contoured to the desired shape to ensure proper fit. This modification ensures that the crown conforms to the tooth's requirements without the need for complete replacement or resizing of the crown. Conversely, when a crown is oversized, the diameter can be reduced by creating a V-shaped cut on the buccal surface of the metal edges of the best-sized crown. The edges are then reapproximated and the overlapping margins are welded together to restore the crown's fit. These adjustments are crucial in achieving the precise fit required for optimal functional and aesthetic outcomes [6].

Hall Technique

In 2006, Dr. Norna Hall introduced a revolutionary technique for arresting dental caries in pediatric patients, which is both quick and minimally invasive. The Hall technique involves placing a crown without the use of local anesthesia, without preparing the tooth, and without eliminating the caries. This method was designed primarily to enhance the comfort of both the child and the operator, particularly in managing anxious pediatric patients. The biological foundation of the Hall technique is based on the principle that by isolating the superficial layer of biofilm and carious lesion from the oral cavity, the composition of the biofilm will gradually shift to a less cariogenic microflora, ultimately halting the progression of caries [25]. While the Hall technique provides a non-invasive solution, there are several concerns associated with its use. One notable issue is the potential for the use of orthodontic appliances, which can be time-consuming. Additionally, the lack of tooth preparation may result in premature contacts and an increased occlusal vertical dimension, though these issues can typically be corrected at a follow-up appointment after one year. Another challenge is the aesthetic limitations of the technique, as the crown may be perceived as visually unappealing compared to more traditional restorative approaches [25].

Indications for the Hall Technique

The Hall technique is particularly indicated for children with class 1 caries that present non-cavitated lesions and who are unable to undergo fissure sealant, partial caries removal, or conventional restorative procedures. It is also suitable for children with class 2 caries, whether cavitated or non-cavitated, who similarly cannot accept fissure sealant or partial caries removal, and do not show signs of pulpal involvement. Furthermore, there must be sufficient sound tooth tissue remaining to retain the crown effectively.

Contraindications for the Hall Technique

The Hall technique is contraindicated in certain cases, including patients with severe caries that exhibit signs of irreversible pulpitis or dental sepsis. It is also not appropriate for crowns that are severely destroyed by caries to the point of being non-restorable. Additionally, children who are at risk of bacterial endocarditis should not be treated using this technique due to the potential for infection [25].

Procedure for the Hall Technique

The procedure begins by placing orthodontic separators between the contact points of the primary molar for 4 or 5 days, thereby creating the necessary space for the crown. The smallest-sized crown that covers all cusps and approaches the contact points, offering a 'spring back' effect, is then selected. Adjustments to the crown can be made using band-forming pliers as necessary. Once the crown is fitted, it is cemented into place using glass ionomer cement. It is critical to maintain the tooth in occlusion until the cement has fully set, after which excess cement can be removed using floss. The Hall technique serves as an effective alternative when traditional crown preparation methods are not feasible or appropriate [25][26].

Complications in Stainless Steel Crown Application

Interproximal Ledge

Incorrect positioning of the bur during tooth preparation can result in the formation of an interproximal ledge, rather than the intended shoulder-free interproximal cutting. If the operator does not address and remove this ledge, it can obstruct the proper seating of the crown, leading to potential complications in the fitting process. This can adversely affect the success of the restoration and require further corrective measures to ensure a proper seal and fit of the crown [6].

Marginal Discrepancy

Numerous studies have demonstrated a clear association between gingival inflammation, particularly gingivitis, and marginal defects in dental restorations. This is often due to improper marginal adaptation and inadequate removal of excess cement. To prevent such issues, careful and precise adaptation of the crown margins prior to cementation is essential. Furthermore, minimizing post-fitting gingivitis can be achieved by thoroughly polishing the crown margin after placement. A comprehensive treatment plan should include oral hygiene instruction, as well as proactive measures to ensure the restoration's longevity and reduce the risk of gingival irritation [8][27].

Inhalation or Ingestion of the Crown

To prevent the risk of aspiration or ingestion of a crown during the procedure, a rubber dam should be placed prior to cementation. However, in some instances, the rubber dam may need to be removed temporarily to prepare the distal surface. Despite these precautions, accidents may still occur, necessitating immediate and decisive action from the clinician and staff. If a crown is accidentally aspirated or ingested, the dental team must remain calm and execute appropriate measures to manage the situation. These actions may include the use of high vacuum suction, performing back-patting after positioning the patient in the prone position, or administering the Heimlich maneuver. Should these interventions fail, a clinical referral for a rapid chest radiograph is necessary to assess the location of the crown. If the crown remains lodged in the lung or bronchial passages, bronchoscopy may be required to remove the foreign object. In such cases, prompt medical and surgical intervention is critical to avoid severe complications and ensure the patient's safety [28].

Clinical Significance

Primary teeth are particularly vulnerable to caries due to their larger pulp chambers and prominent pulp horns, which impose specific challenges on cavity design. This makes primary teeth more susceptible to extensive decay and, therefore, necessitates the use of full-coverage restorations. While stainless steel crowns do have an aesthetic disadvantage, they are widely considered the treatment of choice for pediatric patients due to several key benefits, including their durability, efficiency, longevity, cost-effectiveness, and reliability. Although alternative tooth-colored restorations are available, these often come at a higher cost or require more extensive tooth reduction, increasing the risk of pulp exposure and complicating the restoration process [15][29].

Enhancing Healthcare Team Outcomes

Dental caries remains the most prevalent oral disease in children globally, affecting between 1% and 12% of children in developed countries, with prevalence rates as high as 70% in developing regions [25]. The management of caries in primary dentition is particularly challenging due to the need for behavior management and long-term treatment plans until the affected teeth exfoliate naturally. Stainless steel crowns offer a highly effective solution to these challenges. Despite the proven efficacy of stainless steel crowns, studies indicate that pediatric dentists are more likely to use them for restoring carious primary teeth than general dentists [30]. To improve the use of this treatment among general practitioners, increased training at the undergraduate level, along with access to postgraduate courses, is essential to enhance the adoption of this reliable and efficient restorative approach [30-31].

Conclusion:

Stainless steel crowns (SSCs) have proven to be one of the most effective and reliable restorative options in pediatric dentistry, particularly for managing primary teeth affected by severe caries, developmental defects, and trauma. Since their introduction in the mid-20th century, SSCs have been widely recognized for their strength, longevity, and ability to provide comprehensive protection for severely damaged teeth. One of the significant advantages of SSCs is their ability to withstand the functional demands placed on them by children, ensuring the protection of primary teeth until their natural exfoliation. The placement of SSCs is also simpler compared to other restorative methods, such as amalgam or composite fillings, making them a preferred choice in many pediatric dental practices. However, the use of SSCs in clinical practice is not without its challenges. One of the main reasons for hesitation among some dental professionals is the perception of complexity in the placement procedure. While studies have demonstrated that SSCs are relatively straightforward to place, misconceptions about their application persist. Additionally, some clinicians express concerns about the esthetic appearance of SSCs, especially when compared to tooth-colored alternatives. Despite these concerns, the durability and cost-effectiveness of SSCs far outweigh these drawbacks, especially in cases where long-term restoration is necessary. The indications for SSCs are broad, ranging from caries management following pulp therapy to the restoration of teeth affected by developmental anomalies or trauma. They are also highly beneficial for patients at high risk for caries, providing a durable and reliable solution in challenging cases. On the other hand, certain contraindications exist, such as advanced root resorption or patient non-cooperation, which may necessitate alternative treatment options. Educational initiatives and focused training can help reduce the barriers to the adoption of SSCs, ensuring that dental professionals fully understand their benefits and the procedures for their proper placement. These efforts could help improve the overall standard of pediatric dental care by promoting a more widespread use of SSCs, leading to better long-term oral health outcomes for children. In conclusion, stainless steel crowns remain a cornerstone of pediatric restorative dentistry. Their advantages in terms of durability, strength, and cost-effectiveness make them an ideal choice for managing severely decayed primary teeth. Addressing the professional hesitations around their use through targeted education and training will enhance their acceptance and utilization in clinical practice, ultimately benefiting young patients by ensuring optimal oral health outcomes.

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