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Comparing Socket Shield Technique and Conventional Immediate Implant Protocol for Anterior Tooth Rehabilitation: A Critical Analysis of a Systematic Review

Comparación de la Técnica de Socket Shield y el Protocolo Convencional de Implante Inmediato para la Rehabilitación de Dientes Anteriores: Análisis Crítico de una Revisión Sistemática

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ABSTRACT: The Socket Shield Technique (SST), a procedure utilized in dental implantology, entails retaining a section of the natural tooth root (the socket shield) in place when an adjacent tooth is extracted, and an implant is placed in the same area. While the technique presents certain advantages, numerous investigations into SST lack of well-designed prospective randomized clinical trials at long term, compromising the credibility and reliability of their findings. The objective of this study was to critically appraise and grade the level of evidence of a systematic review that compare the SST with the conventional immediate implant protocol (CIIP) for anterior tooth rehabilitation. A recent systematic review was appraised to assess the quality and consistency of the study findings. This assessment utilized the Strength of Recommendation Taxonomy (SORT) to facilitate the application of research results to clinical practice decision-making. The assessment of the quality and reliability of the systematic review and meta-analysis revealed that the evidence obtained from the study was graded with a strength of recommendation B and a level of evidence 2. SST seems to be a feasible procedure. However, there is insufficient evidence to recommend this technique as an alternative to CIIP in daily practice. Evidence from long-term studies with proper methodology and an adequate sample size is needed to support socket shield technique as an alternative treatment to the conventional immediate implant protocol.

KEY WORDS: aesthetic rehabilitation, socket shield technique, immediate dental implant, meta-analysis, critical appraisal.

INTRODUCTION

The field of dental implantology has seen significant progress, with a focus on enhancing the aesthetic results and long-term success of implant procedures. One of the innovations that has generated significant interest in the field is the Socket Shield Technique (SST). SST involves retaining a section of the natural tooth root, known as the "shield," when extracting a tooth for subsequent implant placement. The rationale behind SST is to preserve the buccal bone and soft tissue around the implant site, aiming for enhanced esthetic and functional results (Lin *et al*., 2022). One of the primary attractions of SST is its capacity to reduce the need for invasive bone grafts, a common requirement in implant surgeries, particularly in the anterior aesthetic region (Kumar & Kher, 2018). However, the socket shield technique is not without its share of controversies and challenges. One of the central issues is related to the limited clinical data available. Many of the studies exploring SST outcomes have been compromised by the lack of well-designed prospective randomized controlled trials (RCTs) (Blaschke & Schwass, 2020).

To address these controversies, systematic reviews and clinical studies have been conducted to evaluate the effectiveness of the socket shield

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technique. While systematic reviews are generally considered a high level of evidence, it's important to note that their quality can vary depending on the rigor of the review process and the quality of the studies included (Pussegoda *et al*., 2017). Therefore, it is essential to critically assess the methodology and findings of any systematic review before making decisions or drawing conclusions based on it. The aim of this study is to provide evidence regarding its potential benefits and complications of SST compared to conventional implant placement in the esthetic zone through a critical appraisal of the most recent systematic review and grade its level of evidence.

MATERIAL AND METHOD

A systematic review by Salem *et al*. (2022) was appraised and the level of evidence graded using Strength of Recommendation Taxonomy (SORT) (Ebell *et al*., 2004).

Summary of the study appraised. Clinical question: Does the socket shield technique improve aesthetic outcomes in the anterior zone compared to conventional immediate implant protocol?.

Subjects or Study Selection. The authors searched in Google Scholar, Scopus, and PubMed database for prospective observational randomized clinical trials (RCTs) or non-RCTs with subjects in which the selected teeth were endodontically treated/non-restorable permanent anterior teeth indicated for extraction, the fresh sockets were subjected to dental implant placement using the socket shield technique (SST) and/ or conventional immediate implant placement (CIIP), with a follow-up period of at least 1 month; outcome measures were assessed by clinical indices and/or radiographic images. Exclusion criteria were: (1) Immature teeth with incomplete root apex formation; (2) Teeth with external/ internal resorption, vertical root fractures on the buccal aspect, and horizontal fractures below bone level; (3) Teeth with periodontitis and periodontal disease; (4) Root portions not left behind intentionally to preserve the buccal bone crest; (5) Patients subjected to delayed implant placement; (6) Laboratory and animal-based studies, qualitative and/ or quantitative reviews, commentaries, letters to the editor, and case series/case reports; and (7) Studies not related to SST for implant placement.

A search strategy was developed in PubMed and was adapted for use in the Google Scholar and Scopus databases, combining terms such as “socket shield technique”, "root submergence technique”, "root membrane technique” and “anterior teeth aesthetic rehabilitation”. Articles obtained were filtered using the following strategy: the available texts were abstracts, free, and non-free full texts; the trial types were RCTs and non-RCTs; publication dates were from January 2010 up to June 2020; the species was humans; sex was male or female; and the age was more than 16 years. No restriction for language type was considered. Hand searches for relevant abstracts, books and reference lists were conducted.

The full texts of relevant studies considered after screening of titles and abstracts were evaluated for specified eligibility criteria by two authors independently. Any disagreement was resolved through discussion with a third reviewer. Selection and data collection were conducted by two authors according to the selection criteria. The quality of the studies was independently evaluated by two authors using the Cochrane Collaboration’s tool for assessing the risk of bias for human RCTs.

Key Study Factor. Systematic review and meta-analysis of seven studies analyzing the aesthetic results obtained with SST compared to the conventional immediate implant protocol (CIIP) for anterior tooth rehabilitation.

Main Outcome Measure. A descriptive table was presented with the characteristics of the studies: reference ID, year, journal, study design, number of patients (Pt) (N), sex, age, number of implants (N), implant distribution (single and/or multiple), type of loading, outcome measures and follow-up period.

The main outcome measure evaluated was the Pink Esthetics Score (PES), at 6 and 12 months, for SST and CIIP, with standard differences in means and 95 % confidence interval as effect size (ES) values.

Study Main Results. Of the 175 references identified through the search strategy and hand searching, only seven unduplicated prospective controlled RCTs and non-RCTs were included (N= 7: 3 RCTs and 4 non-RCTs).

At the 6-month evaluation, the lowest mean score (PES) was 8.85 ±1.81 for CIIP and 11.2 ±0.91 for SST and the highest mean score was 11.73 ±1.67 for CIIP and 12.30 ±0.86 for SST. Meanwhile, at the 12-month evaluation, the lowest mean score (PES) was 9.63 ±1.34 for CIIP and 11.1 ±0.73 for SST and the highest mean score was 11.83 ±0.94 for CIIP and 13.25 ±0.75 for SST.

Meta-analysis showed a standard difference=1.07; SE=0.19; 95 %CI=0.69 to 1.44 after a 6-month follow-up (four studies) and a standard difference=1.43; SE=0.18; 95 %CI=1.07 to 1.79 after a 12-month follow-up (five studies). Similar results were found after both periods of follow-up, in which the standard difference in mean and 95 % CI favored SST over CIIP for the aesthetic rehabilitation of anterior teeth, as all studies fell within the range from no effect (0.00) to positive effect (3.00). However, the heterogeneity between studies was moderate to high and very few well-conducted prospective RCTs and non-RCTs were included in the meta-analysis, which limits the conclusions.

Study Conclusions. Despite the limitations of the systematic review and meta-analysis, the authors reached a promising conclusion regarding the effectiveness of the SST technique in aesthetic zone rehabilitation when compared to CIIP. Nevertheless, in order to confirm and support the validity of this finding, suggest further studies employing robust methodologies and larger sample sizes are warranted.

RESULTS

Critical appraisal

The review questions were clearly defined by following the PICO (patient/population, intervention, comparison and outcomes) approach. The population was adult patients with endodontically treated/non-restorable permanent mature anterior teeth indicated for extraction; the intervention was immediate implant placement using SST; the comparator was CIIP; the outcome was the pink aesthetic score measured for aesthetic rehabilitation of anterior teeth. The inclusion criteria were limited to ideal cases, which had preserved the root structure.

The technique described as conventional, which served as a control, shows variability in the procedures and its protocols lack clear descriptions.

Moreover, key factors that contribute to the aesthetic success of anterior implant restorations were not considered or analyzed in detail. These factors include the gingival phenotype, which was not analyzed in all seven studies included in the review.

The search method was well designed and applied. Selection, data extraction and assessing risk of bias were carried out independently by two authors. As a result of this process, the authors selected seven small studies (sample size 10 to 40 participants, with a follow-up from 6 to 36 months). The primary outcome was Pink Aesthetic Score (PES) (Fürhauser *et al*., 2005), which is assessed by visual inspection of standardized photographs. There was no mention of the assessors' calibration before the assessment of this score.

Their finding was that SST has advantages over CIIP for the aesthetic rehabilitation of anterior teeth after both 6 and 12 months. However, the authors concluded that it is not feasible to recommend SST as an alternative treatment modality with the same level of long-term predictability as CIIP. This conclusion arises primarily from the relatively short-term evaluation period employed in the included studies.

The selected studies showed a notable level of heterogeneity, as indicated by I^2 (moderate to high) and I^2 (above 0).

Adverse effects or complications were not assessed or reported in this study.

Using SORT, the recommendation of grade B with an evidence level of 2 was made based on the limited evidence and high heterogeneity among studies.

DISCUSSION

Systematic reviews vary in quality, and thus, a comprehensive critical assessment is required. This evaluation is essential to establish the fundamental insights necessary for well-informed decision-making regarding the efficacy and safety of dental procedures, such as the Socket Shield Technique.

The main objective of the critically appraised this systematic review and meta-analysis was to evaluate whether there are differences in aesthetic results in the anterior region when comparing the socket shield technique (SST) and conventional immediate implant placement (CIIP).

The SST has been proposed to maintain the periodontal ligament, thus preventing bone resorption and associated aesthetic issues by preserving the architecture of hard tissues and the gingival contour post-extraction (Hürzeler *et al*., 2010; Lin *et al*., 2022). However, SST is restricted to ideal cases that are far from routine clinical practice and demands a high level of surgical expertise, making it a challenging procedure even for experienced operators (Aslan, 2018; Lin *et al*., 2022).

In addition, the lack of a defined protocol in this field has resulted in reports of complications in the literature (Siormpas *et al*., 2014; Szmukler-Moncler *et al*., 2015; Gluckman *et al*., 2016; Gharpure & Bhatavadekar, 2017; Gluckman *et al*., 2018; Blaschke & Schwass, 2020; Lin *et al*., 2022; Sutariya *et al*., 2022) such as infections (Bäumer *et al*., 2015; Schwimer *et al*., 2018; Blaschke & Schwass, 2020), problems related to implant osseointegration (Bäumer *et al*., 2015; Blaschke & Schwass, 2020), peri-implantitis (Schwimer *et al*., 2018; Blaschke & Schwass 2020) and aesthetic deficiencies, including soft tissue exposure (Siormpas *et al*., 2014; Szmukler-Moncler *et al*., 2015; Gluckman *et al*., 2016, 2018; Blaschke & Schwass 2020) and soft tissue perforation (Gluckman *et al*., 2018), which require subsequent management through the use of bone and connective grafts (Schwimer *et al*., 2018; Blaschke & Schwass, 2020).

CIIP is a predictable technique with high success and survival rates, and its benefits have been clearly described in the literature (Sutariya *et al*., 2022). However, it is essential to perform an atraumatic extraction and use a protocol that ensures long-term success in order to maintain gingival architecture and predictable aesthetic results in the aesthetic zone (Jofre *et al*., 2012; Siormpas *et al*., 2014; Szmukler-Moncler *et al*., 2015; Gluckman *et al*., 2016, 2018; Saijeva & Juodzbalys, 2020; Sutariya *et al*., 2022).

Primary studies included in the systematic review did not consider key factors that contribute to the aesthetic success of anterior implant restorations. Gingival biotype is crucial for aesthetics given that thin phenotypes are three times more prone to gingival recession (Blanco *et al*., 2019). Other factors that should have been considered, include the use of bone graft, surgical technique, implant position and diameter, and crown abutment design (Ross *et al*., 2014). The aforementioned points, along with the use of gingival grafts and non-immediate loaded provisional restoration, should be considered to ensure long-term success (Blanco *et al*., 2019) and enable a standardized comparison of both techniques.

The primary outcome was the PES (Fürhauser *et al*., 2005), it is imperative to emphasize the importance of training and, ideally, calibration of at least two operators before conducting an assessment. Notably, the authors did not provide a comprehensive description of the primary studies regarding this crucial aspect, which has the potential to introduce bias into the results.

The authors acknowledged that a limitation of the study was its reliance on English-language publications. However, it appears that this factor had minimal influence on the effect estimates and conclusions.

The analysis and interpretation of the findings in this study require further clarification that allows appraising the study more accurately. Lack of information or reports, difficult this analysis and lead to a uncertainty of the evidence which can affect the reliability of the study conclusions.

The authors used a fixed model to combine data, assuming that the standard error was similar across all studies. However, the results obtained showed a notable level of heterogeneity. This variability could be attributed to the different study designs, small sample sizes, and variations in the interventions they employed. They also stated that participants were of similar ages and had similar surgical conditions; however, some studies lacked data on age and sex. Given these observations, it would be more appropriate to use a random-effects model for the meta-analysis, given the inherent variability in the included studies (Dettori *et al*., 2022).

The authors should emphasize the need for caution when interpreting their results. Furthermore, a comprehensive analysis of heterogeneity should be carried out to provide clear suggestions for future studies.

Reporting of adverse events is crucial for patient safety, informed decision-making, scientific validity, regulatory compliance, and advancing medical knowledge. This systematic review did not consider including the assessment of this relevant outcome.

Future research should focus on assessing aesthetic parameters in the anterior sector, including elements of pink and white aesthetics, in order to either validate or refute implant protocols for use in the aesthetic zone (Belser *et al*., 2009). To achieve this, the utilization of a modified Pink Aesthetic Score (PES/White Esthetic Score (WES)) (Belser *et al*., 2009) is recommended, as it is a user-friendly and highly reproducible parameter (Tettamanti *et al*., 2016).

Additionally, it is crucial to consider factors that play a pivotal role in determining the aesthetic outcome, such as implant diameter, surgical technique, clinical crown abutment design, gingival biotype, the utilization of gingival grafts, and the use or not of immediate provisional protocol.

It is important to highlight that these findings were based on a meta-analysis that included only a small number of prospective RCTs and non-RCTs. Smaller sample sizes from a limited number of studies can lead to reduced statistical power which implies that may not have the ability to detect small but potentially important effects.

CONCLUSION

In conclusion, SST seems to be a feasible procedure. However, there is not enough evidence to recommend this technique as an alternative to CIIP in daily practice. The included studies presents several limitations that posing challenges in acquiring reliable evidence for informed decision-making. Long-term studies with proper methodology and an adequate sample size are needed to address the question of whether the Socket Shield Technique could be an alternative treatment to the Conventional Immediate Implant Protocol.

CIIP, supported by a substantial body of evidence, remains the more reliable choice for dental implant procedures in the aesthetic zone.

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RESUMEN: La técnica Socket Shield (SST), un procedimiento utilizado en implantología dental, implica retener una sección de la raíz natural del diente (cuando se extrae un diente adyacente y se coloca un implante en la misma área. Aunque la técnica presenta ciertas ventajas, numerosas investigaciones sobre la SST carecen de ensayos clínicos aleatorios prospectivos bien diseñados a largo plazo, comprometiendo la credibilidad y confiabilidad de sus hallazgos. El objetivo de este estudio fue evaluar críticamente y clasificar el nivel de evidencia de una revisión sistemática que compara la SST con el protocolo convencional de implante inmediato (CIIP) para la rehabilitación de dientes anteriores. Se evaluó una revisión sistemática reciente para analizar la calidad y consistencia de los hallazgos del estudio. Esta evaluación utilizó la Taxonomía de Fuerza de Recomendación (SORT) para facilitar la aplicación de los resultados de la investigación en la toma de decisiones clínicas. La evaluación de la calidad y confiabilidad de la revisión sistemática y metaanálisis reveló que la evidencia obtenida del estudio se clasificó con una fuerza de recomendación B y un nivel de evidencia 2. La SST parece ser un procedimiento factible. Sin embargo, hay evidencia insuficiente para recomendar esta técnica como alternativa al CIIP en la práctica diaria. Se necesitan estudios a largo plazo con una metodología adecuada y un tamaño de muestra suficiente para respaldar la técnica de Socket Shield como tratamiento alternativo al protocolo convencional de implante inmediato.

PALABRAS CLAVE: rehabilitación estética, técnica de socket shield, implante inmediato, meta-análisis, evaluación crítica.

REFERENCES

Aslan, S. Improved volume and contour stability with thin socket-shield preparation in immediate implant placement and provisionalization in the esthetic zone. *Int. J. Esthet. Dent., 13(2)*:172-83, 2018.

Bäumer, D.; Zuhr, O.; Rebele, S.; Schneider, D.; Schupbach, P. & Hürzeler, M. The socket-shield technique: first histological, clinical, and volumetrical observations after separation of the buccal tooth segment – a pilot study. *Clin. Implant Dent. Relat. Res., 17(1)*:71-82, 2015.

Belser, U. C.; Grütter, L.; Vailati, F.; Bornstein, M. M.; Weber, H. P. & Buser, D. Outcome evaluation of early placed maxillary anterior single-tooth implants using objective esthetic criteria: a cross-sectional.; retrospective study in 45 patients with a 2- to 4-year follow-up using pink and white esthetic scores. *J. Periodontol., 80(1)*:140-51, 2009.

Blanco, J.; Carral, C.; Argibay, O. & Liñares, A. Implant placement in fresh extraction sockets. *Periodontol., 2000, 79(1)*:151-67, 2019.

Blaschke, C. & Schwass, D. R. The socket-shield technique: a critical literature review. *Int. J. Implant Dent., 6(1)*:52, 2020.

Dettori, J. R.; Norvell, D. C. & Chapman, J. R. Fixed-effect vs random-effects models for meta-analysis: 3 points to consider. *Global Spine J., 12(7)*:1624-6, 2022.

Ebell, M. H.; Siwek, J.; Weiss, B. D.; Woolf, S. H.; Susman, J.; Ewigman, B. & Bowman, M. Strength of recommendation taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. *J. Am. Board Fam. Pract., 17(1)*:59-67, 2004.

Fürhauser, R.; Florescu, D.; Benesch, T.; Haas, R.; Mailath, G. & Watzek, G. Evaluation of soft tissue around single-tooth implant crowns: the pink esthetic score. *Clin. Oral Implants Res., 16(6)*:639-44, 2005.

Gharpure, A. S. & Bhatavadekar, N. B. Current evidence on the socket-shield technique: a systematic review. *J. Oral Implantol., 43(5)*:395-403, 2017.

Gluckman, H.; Du Toit, J. & Salama, M. The pontic-shield: partial extraction therapy for ridge preservation and pontic site development. *Int. J. Periodontics Restorative Dent., 36(3)*:417-23, 2016.

Gluckman, H.; Salama, M. & Du Toit, J. A retrospective evaluation of 128 socket-shield cases in the esthetic zone and posterior sites: Partial extraction therapy with up to 4 years follow-up. *Clin. Implant Dent. Relat. Res., 20(2)*:122-9, 2018.

Hürzeler, M. B.; Zuhr, O.; Schupbach, P.; Rebele, S. F.; Emmanouilidis, N. & Fickl, S. The socket-shield technique: a proof-of-principle report. *J. Clin. Periodontol., 37(9)*:855-62, 2010.

Jofre, J.; Valenzuela, D.; Quintana, P. & Asenjo-Lobos, C. Protocol for immediate implant replacement of infected teeth. *Implant Dent., 21(4)*:287-94, 2012.

Kumar, P. R. & Kher, U. Shield the socket: Procedure.; case report and classification. J. Indian Soc. Periodontol., 22(3):266-72, 2018.

Lin, X.; Gao, Y.; Ding, X. & Zheng, X. Socket shield technique: A systemic review and meta-analysis. *J. Prosthodont. Res., 66(2)*:226-35, 2022.

Pussegoda, K.; Turner, L.; Garritty, C.; Mayhew, A.; Skidmore, B.; Stevens, A.; Boutron, I.; Sarkis-Onofre, R.; Bjerre, L. M.; Hróbjartsson, A.; *et al*., Systematic review adherence to methodological or reporting quality. *Syst. Rev., 6(1)*:131, 2017.

Ross, S. B.; Pette, G. A.; Parker, W. B. & Hardigan, P. Gingival margin changes in maxillary anterior sites after single immediate implant placement and provisionalization: a 5-year retrospective study of 47 patients. *Int. J. Oral Maxillofac. Implants, 29(1)*:127-34, 2014.

Saijeva, A. & Juodzbalys, G. Immediate Implant Placement in Non-Infected Sockets versus Infected Sockets: a Systematic Review and Meta-Analysis. *J. Oral Maxillofac. Res., 11(2)*:e1, 2020.

Salem, A. S.; Mowafey, B.; El-Negoly, S. A. & Grawish, M. E. Socket-shield Technique vs Conventional Immediate Implant Placement for Esthetic Rehabilitation: A Systematic Review and Meta-analysis. *J. Contemp. Dent. Pract., 23(2)*:237-244, 2022.

Schwimer, C.; Pette, G. A.; Gluckman, H.; Salama, M. & Du Toit, J. Human histologic evidence of new bone formation and osseointegration between root dentin (unplanned socket-shield) and dental implant: case report. *Int. J. Oral Maxillofac. Implants.; 33(1)*:e19-e23, 2018.

Siormpas, K. D.; Mitsias, M. E.; Kontsiotou-Siormpa, E.; Garber, D. & Kotsakis, G. A. Immediate implant placement in the esthetic zone utilizing the "root-membrane" technique: clinical results up to 5 years postloading. *Int. J. Oral Maxillofac. Implants, 29(6)*:1397-405, 2014.

Sutariya, P. V.; Mehta, S. P.; Upadhyay, H. H.; Pathan, M. R.; Patel, S. R. & Bhatia, Y. A. The soft tissue esthetic outcome with and without immediate provisionalization in immediate implants: A systematic review and meta-analysis. *J. Indian Prosthodont. Soc., 22(1)*:2-12, 2022.

Szmukler-Moncler, S.; Davarpanah, M.; Davarpanah, K.; Capelle-Ouadah, N.; Demurashvili, G. & Rajzbaum, P. Unconventional implant placement part III: implant placement encroaching upon residual roots - A report of six cases. *Clin. Implant Dent. Relat. Res., 17 Suppl 2*:e396-405, 2015.

Tettamanti, S.; Millen, C.; Gavric, J.; Buser, D.; Belser, U. C.; Brägger, U. & Wittneben, J. G. Esthetic evaluation of implant crowns and peri-implant soft tissue in the anterior maxilla: comparison and reproducibility of three different indices. *Clin. Implant Dent. Relat. Res., 18(3)*:517-26, 2016.

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