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INSTITUTO UNIVERSITÁRIO
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Clinical application of prosthesis with telescopic crowns

Clique ou toque aqui para introduzir texto.

Matteo Ticozzi

Dissertação conducente ao Grau de Mestre em Medicina Dentária (Ciclo Integrado)

Gandra, 17 de julho de 2021



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Trabalho realizado sob a Orientação de Mestre Catarina Calamote

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Eu, acima identificado, declaro ter atuado com absoluta integridade na elaboração deste trabalho, confirmo que em todo o trabalho conducente à sua elaboração não recorri a qualquer forma de falsificação de resultados ou à prática de plágio (ato pelo qual um indivíduo, mesmo por omissão, assume a autoria do trabalho intelectual pertencente a outrem, na sua totalidade ou em partes dele). Mais declaro que todas as frases que retirei de trabalhos anteriores pertencentes a outros autores foram referenciadas ou redigidas com novas palavras, tendo neste caso colocado a citação da fonte bibliográfica.

AGREDECIMENTOS

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RESUMO

Próteses telescópicas retidas por coroas têm sido utilizadas com sucesso em pacientes parcialmente desdentados. Este tipo de retentor fornece orientação, suporte e proteção contra o movimento de deslocamento e transfere as forças de mordida ao longo do eixo dos dentes pilares. Os T-RDP oferecem diferentes tipos de aplicação clínica: em prótese parcial removível, ou numa “*overdenture*,” suportada por implante ou em combinação de dentes naturais e implante. Este trabalho tem como objetivo realizar uma revisão integrativa da literatura publicada para analisar a aplicação clínica do uso de coroas telescópicas em próteses removíveis e entender se as coroas telescópicas trazem benefícios clínicos. Foi realizada uma pesquisa no PUBMED e dos 169 artigos encontrados, apenas 20 foram considerados relevantes. Os resultados mostram um conceito de tratamento de longo prazo favorável para dentições reduzidas e severamente reduzidas, com uma alta taxa de sobrevivência, bem como uma melhoria na qualidade de vida em comparação com as próteses convencionais. Os benefícios mais importantes para o paciente e para o médico Dentista são a higiene domiciliar mais eficiente que resulta numa melhor condição gengival, em particular nos pacientes idosos, e, conseqüentemente, a baixa prevalência da doença periodontal e peri-implantar. A combinação de dentes e implante resulta numa vantagem prognóstica melhor em dentes com posição desfavorável, reduzindo a incidência de complicações nos dentes pilares. Verificaram-se poucas complicações biológicas e técnicas como sendo a descementação, a fratura da base da prótese e a necessidade de rebasamento e ou fraturas dentárias.

Palavras-chave: telescopic denture; removable denture; double crown; overdenture

ABSTRACT

Telescopic crown-retained prostheses have been successfully used in partially edentulous patients. This type of retainer provides guidance, support, and protection from dislodging movement, and it transfers bite forces along the long axis of the abutment teeth. T-RDP offer different type of clinical application: a removable partial denture, an implant-supported “*overdenture*” or the combination of natural teeth and implant. This dissertation aims to conduct a review of the published literature to analyze the clinical application and benefits of using telescopic crowns in the removable prosthesis and understand whether telescopic crowns bring clinical benefits. A search was conducted in PUBMED and of the 169 articles found, only 20 were considered for being more relevant. The results show a favorable long term treatment concept for reduced and severely reduced dentitions, with a long-term high survival rate as well as an improvement in quality of life compared with conventional dentures. The most favorable benefits for patient and doctor are more efficient home-care hygiene and result in a better gingival condition in particular for elder’s patient and consequently low prevalence of the peri-implant disease. A combination of teeth and implant result in the prognostic advantage of survival teeth in unfavorable position and reduce the incidence of abutment complication. Few biological and technical complication were observed as decementation, fracture of the denture base, the need for relining and tooth fractures.

Keywords: telescopic denture; removable denture; double crown; overdenture



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Abbreviation Index

C-RDPs: Clasp retained removable dental prostheses

DCRDs: tooth–implant-supported double crown retained dentures

DRPDs: Double crown retained removable partial denture

FTC: Frictional telescopic crown

FISDPs: Fixed implant supported dental prostheses

IODs: Implant-support overdentures

NSRD: Not severely reduced dentition

RDPs: Removable dental prostheses

RISDPs: Removable implant supported dental prostheses

RPD: Removable partial denture

SRD: Severely reduced dentition

TIRPDs: Tooth-implant retained partial dentures

T-RDPs: Telescopic removable dental prostheses

I. INTRODUCTION

Nowadays, more people aged 65 years and above are partially edentulous, and with the improvement of prophylactic programs, people are able to keep their natural teeth longer, therefore, more people in this age require partial dentures. Restoring the missing part of the oral structure, the phonetics and the look is the crucial aim to restore the normal oral health of the patient and improve less or insufficient intake of food (1,2).

Telescopic crown retained removable dental prostheses have been clinically proven to be a successful treatment option for partial edentulism with a high success rate and fewer technical and biologic failures. This retainer provides guidance, support, protection from dislodging movement and allows to preserve the remaining teeth helping in the conservation of alveolar bone, transferring the forces along the long axis of abutment teeth (1,3–7). The most common types are telescopic crowns, conical crowns, and double crowns with an additional retention element (8).

The telescopic crown was first introduced by Bötteger in 1970 and consist of parallel sidewalls with a flank angle very close to 0°. The retention is achieved by the contact of a double crown and these retainers (or attachments) consist of 2 crowns; primary or inner crown which is cemented to the abutment, and secondary or outer crown which is attached to the denture and can be used on both natural teeth and implants (9–13).

The inner coping defends the prepared abutment tooth from decay and also provides stabilization to the prosthesis. The retention is materialized since there is the inner and the outer crown coping tenso-friction mechanism (1,3).

Removable partial dentures (RPDs) are especially indicated in the distal edentulous area with a minimum of two teeth bilaterally present with a good amount of periodontal support or alternative treatment for patients with few remaining teeth (14) or severely reduced dentition (SRD), that are less than 4 teeth in one jaw (15,16). In terms of tooth type, the vital were consider to be favourable to reduce complication in a linear-sagittal distribution (15).

There are widely clinical situations for telescopic prostheses. It can be used as retainers for partial dentures, instead of clasps and precision attachments and

that is called telescopic partial denture, which is usually fabricated with a metal framework. Also, they are indicated for implant-support denture and overdentures; moreover, may be a good choice to connect implants to natural teeth (10). The commonly used attachment system connecting overdentures and implant have included bars, anchors, magnet and locator systems (8).

The most important advantage of a double crown is the possibility to restore a dentition using remaining teeth located in an unfavourable position for other prosthetic reconstruction (3,8,9,17). Other of them are efficient home-care by removing prosthesis, reduction on lateral stress on abutment teeth, minimal cement failure, and are specially indicated for patients with poor manual dexterity (13). Due to the coverage of the abutment teeth, the aesthetic outcome is also more favourable compared to conventional partial denture with hooks and in case of a falling of abutment teeth, the reconstruction can more easily be modified when compared to fixed dental prostheses (1,3,5,6,12,17–20).

The major disadvantages of the telescopic denture are the high demand for precision and special skills required of both the clinical and laboratory, which increases the total cost of the prosthesis. Other frequent problems are the frictional wear during the functional period and technical failures such a loss of cementation, loss of facing, fracture of the metal framework or denture base (2,4,8,10).

II. OBJECTIVES

The objective of this study is to carry out an integrative literature review that aims to analyze the clinical application of prosthesis with telescopic crowns and understand whether if telescopic crowns bring clinical benefits.

III. METHODS

A literature search was performed on PUBMED (via National Library of Medicine) using the following of keywords search terms: “Telescopic Denture”, “Removable Denture”, “Double Crown” and “Overdenture”. The inclusion criteria involved articles published in the English language, up to January 2009, reporting the influence of telescopic crown in prosthesis and the long-term benefit. For the period of 2009-2021 the keywords was combined to reach 169 articles: telescopic denture and overdenture 67; telescopic denture and double crown 22; telescopic denture and removable denture 46; double crown and removable denture 34.

The eligibility inclusion criteria used for article searches also involved: articles written in English; original articles randomised controlled trials; and retrospective studies. The total of articles was compiled for each combination of key terms and therefore the duplicates were removed using Mendeley citation manager. The eligibility exclusion criteria also involved: articles not written in English, reviews and systematic reviews. A preliminary evaluation of the abstracts was carried out to establish whether the articles met the purpose of the study. Selected articles were individually read and evaluated concerning the purpose of this study. The following factors were retrieved: authors 'names, journal, publication year, purpose, sample size, clinical applications, survival rate, biologic compliance and results.

IV. RESULTS

The literature search identified a total of 169 articles in PubMed and after removing the duplicates, we had 135. Following reading the titles and abstracts of the articles, 80 were excluded because they did not meet the inclusion criteria and 55 articles remain for eligibility. The last 35 articles were excluded with reason of systematic review, meta/ analysis, case report and in vitro studies. Thus 20 studies were included in this review.

Of the 20 studies selected, 6 (30%) investigated the survival rate and complication of telescopic crown removable prosthesis, 6 other articles (30%) evaluated the Implant support overdenture retained with telescopic crown and last 8 studies (40%) evaluated the combination of tooth-implant partial dentures retained with telescopic crown(14–16,21–37). The major findings are drawn as follow:

- The prostheses retained with double crown showed comparable clinical long-term success and proved to be a favourable treatment concept for severely reduced dentitions. The survival rate was 87.5% (16) after three years; 84.3% and 100% (21) after 5 years; 93.8% after 7 years; 94.7% (29) at 10 years and 70.8% after 20 years (29).
- The implant-support overdenture offers predictable long-term performance with a limited incidence of biological and technical complications. The survival rate was 100% after 3 years (22); 98.75% after 5.64 ± 3.50 years (32); 62% and 38% after 5 and 8 years (26), 100% after 5 to 8 years and 98.9% after 14.1 ± 2.8 years (10).
- The prosthesis combined tooth and implant may result in a prognostic advantage and promising treatment for a patient with strongly reduce dentition with improvement in the long-term prognosis (23,24,30,31,35).
- The most common observed benefit was the more favourable gingival conditions, around implant and teeth, with good accessibility for cleaning in the context of oral hygiene home-care. That's might reduce the risk for hyperplasia and peri-implantitis (30,32,34,36).

- Few biological and technical complications observed. That's can be prevented with measures such as correctly tooth preparation, cementing procedure (15,16,21).
- The contact stresses developed on the attachment and implant components were less in the locator model when compared to telescopic (37).

Figure 1. Flowchart

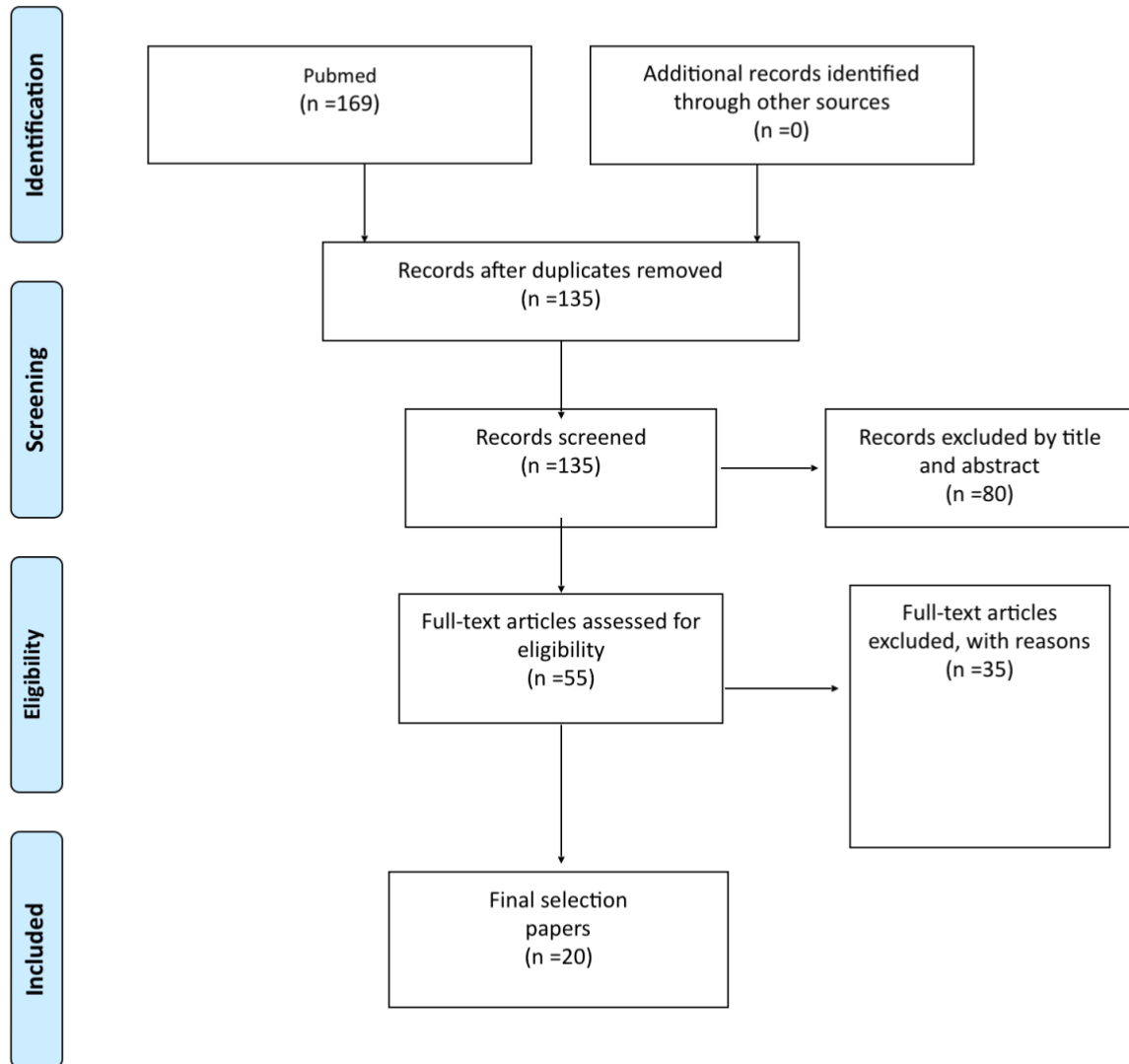


Table 1

Title and Author	Objective	Sample size	Clinical Application	Observed Benefit	Survival rate	Biologic Involvement	Result
<p>Long-term results of implant-supported overdentures retained by double crowns: a practice-based retrospective study after minimally 10 years follow-up (27).</p> <p><i>Eberhard Frisch et al.</i></p>	<p>The aim of this practice-based study was to retrospectively evaluate the long-term clinical outcome of IODs retained by double crowns.</p>	<p>22 edentulous patients were restored between 1991 and 2002 with double-crown-retained IODs.</p>	<p>Implant-support overdenture</p>	<p>The mean radiological bone loss in the present study is 1.8 mm \pm 1.5 mm and less presence of mucositis and peri-implantitis.</p>	<p>The mean follow-up period was 14.1 \pm 2.8 years. One implant failed after 4.9 years (cumulative survival rate: 98.9%).</p>	<p>Seven implants in two patients showed peri-implantitis (prevalence: patient-based = 9.1%/implant-based = 8%). Maintenance procedures were required at a rate of 0.31/year and patient.</p>	<p>This study indicates that IODs retained with double crowns offer predictable long-term performance with a limited incidence of biological and technical complications.</p>
<p>Survival rate of removable partial dentures with complete arch reconstruction using double crowns: a retrospective study (29).</p> <p><i>Koichi Yoshino et al.</i></p>	<p>The purpose of this study was to clinically investigate double-crown-retained removable partial dentures (DRPDs) and abutment teeth at dental clinics.</p>	<p>A total of 174 patients with 213 dentures and 1030 abutment teeth were analysed. Only cases with complete arch reconstruction were included.</p>	<p>Removable partial dentures with double crown.</p>	<p>DRPDs can be used for a long period. Significantly lower extent of prosthetic follow-up and maintenance efforts than a prosthesis with resilient anchoring.</p>	<p>Survival rate at 10 years was 94.7% and at 20 years was 70.8%.</p>	<p>The main reason for denture replacement was loss of abutment teeth 10 years was 83.8% and at 20 years was 66.3.</p>	<p>DRPDs last over 20 years, making them a durable investment in one's oral health; their survival is influenced by loss of abutment teeth.</p>



Title and Author	Objective	Sample size	Clinical Application	Observed Benefit	Survival rate	Biologic Involvement	Result
<p>Double-crown retained removable dental prostheses: A retrospective study of survival and complications (33).</p> <p>Franz Sebastian Schwindling et al.</p>	<p>The purpose of this study was to evaluate the survival of double-crown retained removable dental prostheses in use for 7 years and to determine their most common complications.</p>	<p>117 prostheses in 86 patients with 385 abutment teeth. 32 telescopic-crown retained removable dental prostheses. 51 conical-crown retained removable dental prostheses and 34 resilient telescopic-crown retained overdentures.</p>	<p>Removable partial dentures with double crown.</p>	<p>After 7 years telescopic crown showed the highest survival rate (90%) comparison with conical crown and resilient telescopic crown (78.5%). Minor complication, decementations, veneer failure, and denture base fractures.</p>	<p>After 5 years, the success rate was 100% for; telescopic prosthesis, 91.9% for conical crown, and 90.4% for resilient telescopic crown. After 7 years, 90% of the T-RDPs were successful. Prosthesis survival for all types of prostheses was 93.8% after 7 years.</p>	<p>Decementation of primary crowns (34.2%), failure of the veneer of secondary crowns (11.1%), fracture of the denture base (17.1%), and the need for relining (12%), were common.</p>	<p>The medium-term double-crown prosthesis survival found in this retrospective investigation appears acceptable. However, more laboratory and clinical research is necessary to reduce the incidence of minor complications.</p>
<p>Clinical success of implant-supported and tooth-implant-supported double crown-retained dentures (30).</p> <p>Gunda Bernhart et al.</p>	<p>The objective of this retrospective study was to compare biological and technical complications of implant-supported and tooth-implant-supported double crown-retained dentures.</p>	<p>Sixty-three patients (44 males and 19 females) participated in the study. The mean age was 63.3±8.8 years.</p>	<p>Combined tooth-implant-denture and implant-supported double crown-retained removable dental prostheses.</p>	<p>DCRDs resulted in more favorable gingival conditions for elderly patient, no areas with difficult access for oral hygiene.</p>	<p>Follow-up studies on double crown-retained dentures supported exclusively on natural teeth report survival between 92% and 100%.</p>	<p>Two implants were lost after 1 and 9 months and two cases of peri-implantitis (group ii), two teeth were lost after 21 and 23 months (group tt), Loss of facing was the most frequent technical complicate.</p>	<p>The result indicating that double crowns can be recommended for implant and combined tooth-implant-retained dentures.</p>



Title and Author	Objective	Sample size	Clinical Application	Observed Benefit	Survival rate	Biologic Involvement	Result
<p>Prognosis of implants and abutment teeth under combined tooth-implant-supported and solely implant-supported double-crown-retained removable dental prostheses (24).</p> <p><i>Peter Rammelsberg et al.</i></p>	<p>Objective of this study was to evaluate the incidence of complications in dental implants and abutment teeth used for combined tooth-implant- and solely implant-supported double crown-retained removable dental prostheses (RDPs)</p>	<p>61 patients with 73 RDPs retained by 234 implants and 107 abutment teeth with a mean age of 65 years.</p>	<p>Combined tooth-implant-denture and implant-supported double crown-retained removable dental prostheses (RDPs).</p>	<p>Teeth and implants can be combined to support RDPs without negative effect, implant-supported showed a poor prognosis.</p>	<p>Implant-supported RDPs with 85% success rates of 92% after 5 years compared with exclusively</p>	<p>Six implants failed and eleven implants were diagnosed with peri-implantitis. Four abutment teeth were extracted, and three abutment teeth showed severe complications requiring extended interventions</p>	<p>Preliminary data suggest that the combination of teeth and implants to support double crown-retained RDPs may result in a prognostic advantage. Incident of abutment complication acceptable range, risk decrease by around 25 %</p>
<p>Telescopic crown-retained removable partial dentures on teeth and implants: An 8- to 9-year prospective randomized clinical trial (23).</p> <p><i>Daniel Moll et al.</i></p>	<p>The purpose of this prospective clinical study was to evaluate the outcome of telescopic crown-retained removable dental prostheses on implants and teeth according to different numbers of abutments.</p>	<p>33 patients divided into four subgroups (group_1: 3–4 abutment s/ maxilla, group_2: 5–6 abutment s/maxilla, group_3: 2–4 abutment s/mandible, group_4: 5–6 abutment s/mandible).</p>	<p>Combined tooth-implant-denture retained removable dental prostheses.</p>	<p>The main part of the patients revealed satisfying oral hygiene, around implants and teeth.</p>	<p>After a mean observation time of 8.7 years, all prostheses were still in function. Implant survival rate 98.8% e abutment teeth survival rate 96.6%.</p>	<p>Biological and technical complications were frequent but all prostheses were still in function. 38.5% of all patients were affected by parodontitis , 23.1% by endodontics and 15.4% by peri-implantitis.</p>	<p>The results of this study indicate that the telescopic-crown-prostheses on implants and/or teeth seem to be a promising treatment option for patients with a strongly reduced dentition with improvement in the long-term prognosis.</p>

Title and Author	Objective	Sample size	Clinical Application	Observed Benefit	Survival rate	Biologic Involvement	Result
<p>The up-to-11-year survival and success of implants and abutment teeth under solely implant-supported and combined tooth-implant-supported double crown-retained removable dentures (31).</p> <p><i>Hannah Fobbe et al.</i></p>	<p>The aim was to compare the survival and success of dental implants in solely implant supported Double crown retained removable dentures DCRDs. And combined tooth implant supported DCRDs.</p>	<p>126 patients with 139 DCRDs. The mean age was 65.6±9.1 years. One group of 53 dentures was solely implant supported on 213 implants. The second group of 86 denture was anchored on 239 teeth and 199 implants.</p>	<p>Combined tooth-implant-denture and implant-supported double crown-retained removable dental prostheses.</p>	<p>Combining teeth and implant in one DCRD appears to have a positive effect on implant success.</p>	<p>The cumulative survival rate was 97.2% at five years. Total implant survival rate was 99.5% for tooth implant - supported DCRDs and implant supported was 93.4%.</p>	<p>Implant loss and peri-implantitis occurred mainly in solely implant supported dentures (17%) and 1.2% for combined tooth implant. Thirteen patients with solely implant (27.7%) and three patients with tooth implant (3.7) experienced major complication with the implant.</p>	<p>Survival and success are high for both treatment options. Combining teeth and implant in one DCRD might have a positive effect on the prognosis of implant and the survival of remaining teeth.</p>
<p>Three-Year Analysis of Fixed and Removable Telescopic Attachment-Retained Implant-Supported Dental Prostheses: Survival and Need for Maintenance (34).</p> <p><i>Peter Rehmman et al.</i></p>	<p>The purpose of this clinical study was to evaluate the clinical outcomes of fixed implant-supported dental prostheses (FISDPs) and removable ISDPs (RISDPs) retained by telescopic attachments.</p>	<p>A sample of 233 patients with 157 FISDPs and 76 RISDPs supported by a total of 567 implants was randomized and included in the analysis. The mean observation period was 15.9 ± 15.4 months (maximum, 66.0 months).</p>	<p>Double crown retained fixed implant-supported dental prostheses (FISDPs) and removable ISDPs (RISDPs).</p>	<p>Effective oral hygiene for the patient helping to prevent peri-implantitis for telescopic attachment.</p>	<p>The mean survival rate FISDPs and RISDPs was 87.7% vs 94.8% after 3 years.</p>	<p>Nine prostheses (3.9%) had to be replaced, six were lost in the maxilla and three were lost in the mandible. After 3 years, 87.7% of the FISDPs and 94.8% of the RISDPs remained in function. The need for maintenance is earlier and higher for RISDPs than for FISDP.</p>	<p>The FISDPs and RISDPs show equally good survival rates after 3 years in function. RISDPs showed a greater and earlier need for maintenance during the first years in function.</p>



Title and Author	Objective	Sample size	Clinical Application	Observed Benefit	Survival rate	Biologic Involvement	Result
<p>A 5- to 8-year Retrospective Study Comparing the Clinical Results of Implant-Supported Telescopic Crown Versus Bar Overdentures in Patients With Edentulous Maxillae (22).</p> <p><i>Duohong Zou et al.</i></p>	<p>The objective of this study was to compare implant survival and success rates, peri-implant parameters, and prosthodontic maintenance efforts for implant-supported telescopic crown overdentures and bar overdentures to restore maxillary edentulism.</p>	<p>44 patients with maxillary edentulism received implant-supported removable overdentures. 21 patients chose telescopic crown overdentures and 23 patients chose bar overdentures. A total of 41 patients and 201 implants were available for follow-up.</p>	<p>Implant-support overdenture retained by telescopic crown and bar overdenture.</p>	<p>the prevalence of peri- or interimplant gingival hyperplasia in bar overdenture group was three times higher than that in telescopic crown overdenture group. Hygiene parameters such as calculus and plaque buildup were significantly lower in annual follow-up visits in the telescopic crown.</p>	<p>The survival rate of dental implants in each group was 100%.</p>	<p>There were six cases of peri-/inter-implant gingival hyperplasia. Peri-implant bone resorption was increased slightly during the course of this study, but no significant differences. The gingival hyperplasia mainly occurred around the bar arm.</p>	<p>The implant-supported telescopic crown or bar overdentures are very good treatment options for patients with moderate to severe bone resorption, provided a healthy peri-implant structure for implants in both groups. Although there were higher plaque and calculus levels in the bar group and more maintenance was required for the telescopic crown.</p>
<p>Clinical retention force development of double crowns (28).</p> <p><i>Stefan Bayer et al.</i></p>	<p>The cardinal aim of this study was to investigate the clinical development of the retention force values of double crowns.</p>	<p>23 partially edentulous patients were included in this study.</p>	<p>Prostheses combined fixed-removable with double crown.</p>	<p>This test showed that the retention force of the dentures did not change significantly by the examination period of 18 months.</p>	<p>The measured values were analyzed according to differences between the median retention forces at the three defined points in time.</p>		<p>The results indicate that retention force values of double crowns, do not relevantly change clinically within the first 18 months and 1.5 years.</p>



Title and Author	Objective	Sample size	Clinical Application	Observed Benefit	Survival rate	Biologic Involvement	Result
<p>Overdentures borne on less than four abutments with telescopic crowns: 5-year results of a retrospective clinical study (26).</p> <p><i>Sven Rinke et al.</i></p>	Retrospective evaluation of the clinical performance of tooth-supported overdentures retained by resilient telescopic crowns with occlusal clearance fit in severely reduced dentition (1–3 remaining teeth).	263 resilient telescopic crowns with occlusal clearance in 221 patients were reevaluated in observational period: 64.5 ± 34.8 months.	Overdentures tooth-supported retained by resilient telescopic crowns with occlusal clearance.	No beneficial effects of resilient double-crown design for overdentures was detected in severely reduced dentition.	The 5- and 8-year overdenture survival rates were 62% and 38%.	Secondary caries, loss of vitality, loss of retention of primary crowns, denture teeth fracture, and denture base fracture and a association of success rate and number of abutment teeth.	The survival and success rates of resilient telescopic crowns with occlusal clearance are significantly influenced by the number of abutments.
<p>Telescopic Crowns on Implants and Teeth: Evaluation of a Clinical Study After 8 to 12 Years (35).</p> <p><i>Jaana-Sophia Kern et al.</i></p>	To evaluate the outcome of a clinical study on telescopic-crown-retained removable dental prostheses T-RDPs on implants or implants and teeth after 8 to 12 years.	39 patients received implant- or combined tooth-implant-supported TCR-RDPs in the maxilla and/or mandible.	Combined tooth-implant-denture and implant-supported double crown-retained removable dental prostheses.	Few biologic and technical complications were detected during the observation period after 8 to 12 years. 100% were still functioning successfully after 11.3 years.	implant and tooth survival rates of 97.6% and 81.8% after a mean observation period of 11.3 ± 1.1 years.	2 implants and 10 abutment teeth were lost. Both implants were lost in the same patient in the maxilla. the most frequent biologic complications were caries with 18 events, followed by periodontitis with 13 events, and tooth loss with 10 events.	Implant- or combined tooth-implant-supported T-RDPs provided a satisfying treatment option for patients with severely reduced dentition in the long term.



Title and Author	Objective	Sample size	Clinical Application	Observed Benefit	Survival rate	Biologic Involvement	Result
Clinical Outcome of Double Crown-Retained Mandibular Removable Dentures Supported by a Combination of Residual Teeth and Strategic Implants (14). Sven Rinke et al.	The aim was to conduct a retrospective investigation of the clinical outcome of mandibular tooth-implant-retained partial dentures rigidly retained via telescopic double crowns.	18 patients with reduced residual dentition.	Combined tooth-implant-denture double crown-retained removable dental prostheses.	Low rates of technical and biological complications were observed (screw loosening, acrylic resin fracture repairs, relining).	All 14 dentures were functional (survival rate: 100%); four teeth (survival rate: 85.19%) and no implants (survival rate: 100%) were lost.	Peri-implantitis was observed around one implant (4.17%) and required only limited maintenance.	TIRPDs retained via double crown might represent a viable treatment option in mandibles with few remaining abutment teeth.
Clinical performance of non-precious metal double crowns with friction pins in severely reduced dentitions (15). Sebastian Hinz et al.	The aim to evaluate the 5-year survival rate of DCRDs in patients with severely reduced dentition (SRD) and not severely reduced dentition (NSRD).	158 patients were treated with 182 dentures on 520 abutment teeth.	Removable partial dentures with double crown.	The survival rates of dentures in Steffel classes B–E were comparable with dentures in the NSRD group, may be due to more consistent and homogeneous force distribution in everyday use in triangular supported dentures.	The cumulative survival rate of the NSRD dentures was 100% and for SRD was 80.3% after 5 year.	In the severely reduced dentition, longevity mainly depends on the number and distribution of the abutment teeth. Tooth type had no significant influence on survival.	DCRD dentures showed comparable clinical long-term success to double crown systems that have been previously reported in the literature. In the severely reduced dentition, longevity mainly depends on the number and distribution of the abutment teeth.

Title and Author	Objective	Sample size	Clinical Application	Observed Benefit	Survival rate	Biologic Involvement	Result
<p>Prognosis of double crown-retained removable dental prostheses compared with clasp-retained removable dental prostheses: A retrospective study (21).</p> <p><i>Keita Ishida DDS et al.</i></p>	<p>The present study compared the clinical prognosis of double crown-retained removable dental prostheses (DCRDs) with that of clasp-retained removable dental prostheses (C-RDPs).</p>	<p>201 patients received 52 D-RDPs with 144 abutment teeth (D-teeth) and 199 C-RDPs with 399 abutment teeth (C-teeth). The mean observation period was 38.0 20.3 months.</p>	<p>Double crown-retained removable dental prostheses DCRDs and clasp-retained removable dental prostheses (C-RDPs).</p>	<p>High survival rate in 3.4-6 years, most common problem (decementation) can be prevented with measures such as proper post length, type of luting agent and cementing procedure.</p>	<p>Five-year survival rates of D-RDPs and C-RDPs were 100% and 94.5%.</p>	<p>Decementation was the most frequent cause of failure, which occurred in 76.9% of D-teeth and 28.3% of C-teeth. Vital teeth were considered to be favorable as D-teeth in order to reduce complications.</p>	<p>The prognosis of both types of prostheses and their abutment teeth exhibited favorable survival rates. Although D-RDPs indicated lower complication-free rates of abutment teeth,</p>
<p>Unsplinted implants and teeth supporting maxillary removable partial dentures retained by telescopic crowns: a retrospective study with >6 years of follow-up (36).</p> <p><i>Eberhard Frisch et al.</i></p>	<p>The objective of this research was to perform a retrospective evaluation of the clinical long-term outcome of maxillary TIRPDs rigidly retained via telescopic crowns in patients undergoing supportive post-implant therapy (SIT).</p>	<p>26 patients restored with maxillary TIRPDs between 1997 and 2011 in a private practice.</p>	<p>Combined tooth-implant-denture double crown-retained removable dental prostheses.</p>	<p>Excellent access to the abutments for oral hygiene and a high degree of patient compliance produce a high-implant survival rate and the low prevalence of peri-implant disease. Total incidence of 0.128 treatments per patient per year. No case of abutment loosening.</p>	<p>Teeth survival rate was 86.36% and implant survival rate was 98.36%.</p>	<p>Nine teeth and one implant were lost. 30 implants (50%) in 16 patients (69.57%) showed bleeding on probing, no further peri-implantitis was observed. The mean plaque index was 0.27+/- 0.45, with 43 implants (71.67%) exhibiting no plaque and 17 implants (28.33%) rated as 1.</p>	<p>In summary, the study revealed comparably high success rates and low rates of biological and technical complications for implants and dentures over a >6-year period for maxillary TIRPDs in patients attending supportive post-implant therapy in a private practice.</p>



Title and Author	Objective	Sample size	Clinical Application	Observed Benefit	Survival rate	Biologic Involvement	Result
<p>Double Crown-Retained Maxillary Overdentures: 5-Year Follow-Up (32).</p> <p><i>Eberhard Frisch et al.</i></p>	<p>To perform a retrospective evaluation of clinical outcomes of maxillary overdentures retained on four implants via double crowns.</p>	<p>28 patients with edentulous maxillas.</p>	<p>Implant-support overdenture retained by telescopic crown.</p>	<p>Double crown-retained IODs ensure good accessibility for cleaning in the context of oral hygiene homecare procedures which might reduce the risk for hyperplasia and peri-implantitis.</p>	<p>Twenty patients with 80 implants show survival rate 98.75% with the mean follow-up period of 5.64 ± 3.50 years.</p>	<p>One implant was lost. Eight implants (10.1%) in two patients (10%) showed peri-implantitis (both patients were active smokers).</p>	<p>IODs are a promising treatment for edentulous maxillae offering high implant and prosthesis survival rates and a limited incidence of biological and technical complications.</p>
<p>Longevity of frictional telescopic crowns in the severely reduced dentition: 3-year results of a longitudinal prospective clinical study (16).</p> <p><i>Viola Szentpétery et al.</i></p>	<p>The aims of this study were to estimate risks of telescope loss and abutment tooth loss and to determine abutment tooth mobility over time.</p>	<p>74 patients with severely reduced dentitions received 82 T-RDPs retained with 173 FTCs).</p>	<p>Removable partial dentures with double crown.</p>	<p>Patients mostly "very satisfied", a total of 87% of the patients would choose again, the same T-RDPs that they received at insertion.</p>	<p>The survival rate was 93.9% for abutment teeth and 87.5% for telescopes after 3 years.</p>	<p>11% of teeth fractured and 4.6% of teeth were extracted. Number of telescopes, abutment distribution, vitality, and gender as factors influenced the survival rates.</p>	<p>T-RDPs proved to be a favourable treatment concept for severely reduced dentitions. FTCs can be considered as elements with a good benefit-maintenance relation. A general increase of abutment tooth mobility could not be verified.</p>



Title and Author	Objective	Sample size	Clinical Application	Observed Benefit	Survival rate	Biologic Involvement	Result
<p>Comparison of stress induced in mandible around an implant-supported overdenture with locator attachment and telescopic crowns – a finite element analysis (37).</p> <p><i>Meer Rownaq Ali Abbasi.</i></p>	<p>The aim of the present study is to compare the stress induced in the mandible around IOs, using two different attachment systems, locator and telescopic.</p>	<p>3D finite element models were prepared using Pro/ENGINEER or PTC Creo to simulate 4 clinical situations: IOs using two different attachment systems, locator and telescopic, with and without splinting.</p>	<p>Implant-support overdenture retained by telescopic crown.</p>	<p>The stresses transferred to the supporting structure, cortical bone, were more with locator attachment compared to the telescopic one, in both non-splinted and splinted models.</p>		<p>The contact stresses developed on the attachment and implant components were less in the locator model when compared to telescopic. The stresses in all the components of overdenture were greater in the splinted model compared with the non-splinted one,</p>	<p>The locator attachment might demonstrate superior clinical performance, as the stresses on implant and attachment components were less compared to telescopic. Non-splinted model showed better results in both the attachment types.</p>
<p>Removable four implant-supported mandibular overdentures rigidly retained with telescopic crowns or milled bars: a 3-year prospective study (25).</p> <p><i>Gerald Krennmaier et al.</i></p>	<p>The present study evaluated implant survival/success rate, peri-implant parameters and prosthodontics maintenance efforts for four implant-supported mandibular overdentures (IOD) rigidly retained on either milled bar or double crowns attachments.</p>	<p>51 patients with edentulism received four mandibular implants and complete maxillary dentures, 26 patients for milled bars and 25 patients for double crown.</p>	<p>Implant-support overdenture retained by telescopic crown and bar overdenture.</p>	<p>Less plaque index and calculus index in telescopic crown in comparison with milled bar.</p>	<p>3-year follow-up (dropout rate: 11.8%) presenting a high implant survival/success rate (100%).</p>	<p>Peri-implant marginal bone resorption, pocket depth not differ for both rigid retention modalities. Higher values for plaque and calculus index were noticed for the bar than for the telescopic crown attachments. Less favourable handling properties for telescopic crown attachment.</p>	<p>Rigid anchoring of IOD retained either by bar or telescopic attachments showed high implant success rates and minor prosthodontics maintenance efforts regardless of retention modalities used. Stable denture retention presented healthy peri-implant structure for IOD and bar.</p>

V. DISCUSSION

1. Telescopic dentures with natural teeth

Telescopic removable dental prostheses (T-RDPs) are a successful treatment option in the case of partially edentulous arches (29).

Double crowns have the advantage of transferring occlusal forces along the axis of the abutment teeth because of the circumferential relationship of the secondary crown to its abutment tooth (33). More other advantage associated with long-lasting, chewing comfort, good function, esthetically pleasing, facilitate oral hygiene by removing prostheses and ease to repair in case of extraction of abutment teeth (29).

The first clinical application is the removable partial denture (RPD), different studies evaluated the survival rate and the common complication of the prosthesis. Koichi Yoshino et al, reported that 174 patients with 213 dentures and 1030 abutment teeth that DRPDs last over 20 years, making them a durable investment in one's oral health. The survival rate at 10 years was 94.7% and at 20 years was 70.8%. Another study by Keita Ishida DDS et al. reported that 201 patients received 52 DRPDs with 144 abutment teeth and the 5 years survival rate was 100% and Franz Sebastian Schwindling et al, reported a 7 years survival rate of 90% (21,29,33).

The most frequent cause of failure was descementation of the primary crown, but might be a result of mistakes in tooth preparation, poor fit of the primary crowns or excessive retention forces of the secondary crowns, or errors in the cementation process (16,21,29). Denture base caused complications such as crack/fractures or poor fit, requiring relining. Although most of the observed failures were considered to be reparable (29,33). That's indicated telescopic abutment teeth and denture need intensive maintenance. In particular require precision and skill on the part of both the dental technician and the clinician in the fabrication of double-crown reconstructions and, consequently, and so, increasing the total cost of the prosthesis (21).

A frequent problem of the principle of double crown retention is the frictional wear during the functional period. That's archived by static and dynamic friction with a

large contact surface between the primary and secondary crowns (28). Sufficient friction is essential for effective denture functioning and patient satisfaction (15). A study by Stefan Bayer et al reported the retention force of does not change clinically relevant within the first 1.5 years and seem to be sufficient after 18 months (28).

Another aspect to include is a patient with severely reduced dentition (SRD); Viola Szentpétery et al reported 74 patients with SRD received 82 telescopic removable partial dentures. The results showed T-RDPs proved to be a favorable treatment concept for this clinical background, with a survival rate was 93.9% for abutment teeth and 87.5% for telescopes after 3 years and the patients mostly “very satisfied” (16).

Another study by Sebastian Hinz et al reported a less survival rate for SRD in comparison with NSRD,80% vs 100%, which is most likely due to the greater number and more favorable distribution of abutment teeth, resulting in better denture support (15).

However, T-RDPs dentures showed comparable clinical long-term success to double crown systems that have been previously reported in the literature. The number of abutments supporting the prosthesis and the vitality had a considerable impact on the survival of the denture. The study’s results are in agreement that a small number of abutment teeth negatively affects RPD survival (15,16,29,33).

The vital teeth were considered to be favorable in order to reduce complications. Although these even non-vital teeth survive for a shorter time, their use is recommended for telescopic dentures because the survival probability increased with the number of telescopes (15).

In linear-sagittal distribution, the survival was much better than in diagonal or transversal distribution with the best survival showed three or four telescopes with favorable triangular distribution. This may be due to more consistent and homogenous force distribution in everyday use (15,16).

Even in unfavorable situation T-RDPs can be considered as elements with a good benefit-maintenance relation with a comparable long-term success (15) and making them a durable investment in oral health (29).

2. Overdentures

The second clinical application is Implant-supported overdentures (IODs). This is an accepted and predictable form of treatment for the edentulous jaw. Clinical studies have revealed high survival rates for observational periods of up to 10 years and a high level of patient satisfaction, as well as an improvement in quality of life compared with conventional dentures (27,32).

Eberhard Frisch et al in their study evaluated the long-term clinical outcome of IODs in 22 edentulous patients between 1991 and 2002 and showed a cumulative survival rate of 98.9 % after 14.1 ± 2.8 years where 100% of the prosthetic reconstructions remained functional in the same period of time (27). The same author made another study evaluating the IODs in maxillary in 28 patients and demonstrated a survival rate of 98.7% with a follow up of 5.64 ± 3.50 years (32). In another study Sven Rinke et al showed a lower success term in IODs with 62% and 38% respectively after 5 and 8 years; a possible explanation can be seen in the difference of the included natural abutment teeth and their distribution (26). However, these results, the studies revealed a benefit in term of peri-implantitis, mucositis and limited biologic complication; the patient-related for the first study was 9.1% (32) and 10% (26) for the second study but peri-implantitis was diagnosed only in patients with a smoking habit. That's may indicate smoking has been associated with an increased risk of implant loss in some studies. Another possible reason for a comparatively low rate of biological complications is the compliance of patients in participating in a professional maintenance programmer, with prophylaxis and supportive periodontal therapy (32).

One disadvantage about the telescopic retainer was reported on Meer Rownaq Ali Abbasi et al study, the stress transferred to the cortical bone by the telescopic crown was less in comparison of locator attachment. On other hand, the contact stresses developed on the attachment and implant components were less in the locator model when compared to telescopic (37). This might demonstrate superior clinical performance for the attachment but as reported in previous studies, the long-term performance of a telescope is considered to be an element with a good benefit-maintenance relation when comparable with the long-term success (21,22,27).

The other two studies reported the evaluation of IODs rigidly retained on either milled bar or double crowns attachments. In particular the comparison of implant survival and success rates, peri-implant parameters, and prosthodontics maintenance efforts. Bar overdentures help replace decreased tissue mass and are ideal for patients who had undergone surgical ablation of maxillary tumours or who had genetic defects causing hypodontia or reduced crown development. The first study was conducted by Gerald Krennmair et al. and he reported 51 patients with edentulism received four mandibular implants and complete maxillary dentures, 26 patients for milled bars and 25 patients for double crown. The 3-year follow-up presenting a high implant success rate of 100%, with peri-implant marginal bone resorption, did not differ for both rigid retention modalities (25). The second one was performed by Duohong Zou et al. and he reported 21 patients telescopic crown and 23 patients bar overdentures. A total of 41 patients and 201 implants were available for follow-up. The survival rate of dental implants in each group was 100% with few prosthodontic maintenance procedures. In term of peri-implant bone resorption was increased slightly during the course of this study, but the prevalence of peri or interimplant gingival hyperplasia in the bar overdenture group was three times higher than that in the telescopic crown overdenture group. There were no significant differences between IODs and bar overdenture group in terms of patient satisfaction (22).

Either study shows a benefit in higher hygiene parameters in annual follow-up for the overdenture double crown group. The bar shows an increase in the accumulation of plaque and calculus because of a larger surface area and greater gingival coverage of the bars compared with the telescopic crowns (22,25). In contrast, the number of interventions, per year, per patient, was higher in the telescopic crown than in the bar overdenture group (25).

The implant-supported telescopic crown is a very good treatment option for patients with moderate to severe bone resorption. The high implant success rates and minor prosthodontics maintenance with a limited incidence of biological and technical complications gets patient satisfaction (22,25–27,32).

3. Telescopic dentures with Implants and natural teeth

An association of telescoping double crowns with implants and abutment teeth can be an alternative in a removable prosthesis. Combining these last ones and inserted in strategic positions can improve the stabilization of the RPD (14,30).

In the past, the few remaining teeth in highly reduced dentition, were often extracted in favor of an implant-retained prosthetic reconstruction, and this could be a solution for patient that would like to keep their teeth (30).

Different studies evaluated the clinical outcome of tooth-implant retained partial dentures (TIRPDs) or the comparison between TIRPDs and only implant RDPs with the biological and technical complication. The results show evidence of a high survival rate of the prosthesis after 8 years with survival success of 100% (14), 98.8% (23) and 98.36% (36), 97.6% (35) and 11 years was 97.6% (35); the abutment teeth of 85.19% (14), 96.6% (23), 81.8% (35) and 86.36% (36). Regarding biological and technical aspect Eberhard Frisch et al. reported a low incidence with con screw loosening, acrylic resin fracture repairs and relining as the most common failures (36). But Daniel Moll et al, reported a high incidence of biological and technical complication and the most common were endodontic, followed by peri-implantitis and periodontitis. Technical events were headed by fracture of facing/acrylic saddle, loss of acrylic tooth and fracture of the framework, although all prosthesis were still in function after the observation time (23). Another aspect to consider is that patient revealed that the telescopic denture was easy to clean and resulted in more favourable hygiene (34) and consequently gingival conditions for an elderly patient or with poor manual dexterity, with no areas with difficult access for oral hygiene (30). The excellent access to the abutments teeth and implant with a high degree of patient compliance produce a high implant survival rate and a low prevalence of peri-implant disease (30,34,36). Peri-implantitis was observed in 4.17% (14), 23.8% (23) and in the last study was no further observed (36).

Other studies comparing the clinical outcome of the prosthesis combined and only implant RDPs. According to the previous result, the studies showed a high survival rate and limited biological and technical issue. In an observational time of 5 years, the success rate was 92% (24) and 99.5% (31) for the TIRPDs and 85% (24), 93.4% (31), 94.8% (34) for only implant dentures. In addition, a study

by Hannah Fobbe et al., reported that a prosthesis with the combination of teeth and implant might have a positive effect on the prognosis of implant and the survival of remaining teeth in an unfavourable position (31). In support of the last rate, Peter Rammelsberg et al reported that show that a combination of teeth and implant may result in a prognostic advantage with the incidence of abutment complication decrease by around 25 % (24).

The TIRPDs represents a promising treatment for the patient with reduced and severely reduced dentition with higher success rate and low biological and technical complication. A combination of teeth and implant might have a positive effect on the prognosis of these last with a higher level of oral hygiene for elderly patient (24,30,31,35,36).

VI. CONCLUSION

In the present review, relevant articles reported significant findings on the clinical application of telescopic dentures and the benefit for the patient. The main outcomes of the selected studies can be drawn as follow:

- T-RDPs proved to be a favorable long term treatment concept for reduced and severely reduced dentitions, the survival rate is up to 80% for every clinical application and the patients mostly “very satisfied” as well as an improvement in quality of life compared with conventional dentures.
- This retainer offers different clinical application and is particularly indicated for few remaining or unfavourably distributed abutment teeth, connecting natural teeth to implants and patients with poor manual dexterity.
- The observed benefit was the much more favourable hygiene that results in a better gingival condition in particular for elderly patients or with poor manual dexterity. In addition, this excellent access to the abutments teeth and implant with a high degree of patient compliance produce a high implant survival rate and a low prevalence of peri-implant disease.
- A combination of teeth and implant is an indication that might have a positive effect on the prognosis of implant and the survival of the remaining teeth in an unfavourable position. In support of the last rate, the incidence of abutment complication decreases by around 25 %.
- Few biological and technical complications were observed. The most frequent cause was descementation, fracture of the denture base, the need for relining and tooth fractures. That can be prevented with measures such as correctly tooth preparation and correctly cementing procedure.
- This type of retainer needs intensive maintenance and consequently require precision and skill on the part of both the dental technician and the clinician in the fabrication of double-crown reconstructions, consequently increasing the total cost of the prosthesis.
- The contact stresses developed on the attachment and implant components were less in the locator model when compared to telescopic

but on the other hands, the stress transferred to the cortical bone by the telescopic crown was less in comparison to locator attachment.

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