

Comparison between immediate and conventional implant loading for fixed and removable prosthesis: A Scoping review

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ABSTRACT

A comparison between immediate and early, versus conventional dental implant loading was explored for this scoping review. Identifying whether one loading protocol is superior to the other or if one offers more success with treatment and patient satisfaction can guide clinicians with choice of implant loading system.

Method

An adapted version of the Arksey and O'Malley six step framework for scoping reviews was followed, and which includes identifying the research question, identifying the relevant studies, study selection, charting the data, collating, summarizing, and reporting the results and consultation. A literature search was conducted with refined eligibility criteria using scientific electronic databases such as PubMed, Springer, Cochrane library, Elsevier, Wiley, and Academia for the period ranging from 2002-2024. Data was synthesized, analyzed and narratively reported in themes.

Results

From the total number of records identified (N=190), only 35 full text articles were included for the qualitative synthesis. Factors such as survival and success rates of implants, marginal bone loss, esthetics and patient satisfaction are similar and comparable for immediate, early and conventional dental implant loading systems. The success with using these loading systems is dependent mainly on primary stability, implant stability quotient and the insertion torque value.

Conclusion

This review provided evidence that *immediate, early and conventional* dental loading may be used as successful

treatment options irrespective of whether a fixed or removable prostheses is placed.

Keywords

immediate loading, early loading, conventional loading, primary stability, implant success

INTRODUCTION

Edentulism poses an impact on oral and general health as well as quality of life as well, affecting not only mastication but affects the patient psychologically and socially.¹ Dental implants are widely used as an alternative to conventional removable dentures for replacing missing teeth, even though it is more expensive.²⁻³ This is due to implants offering patients a better sense of confidence and quality of life, being a more predictable procedure with a higher success rate and relatively less complications compared to removable dentures.²

Researchers have identified many factors that are indicative of the successful performance of dental implants, one of which is biocompatibility.⁴⁻⁵ It does not only involve the compatibility of the material with the tissue but also the ability to perform a specific function meaning that biocompatibility is not only dependent on the physical, chemical and mechanical properties of the material but the application of the material as well. The biocompatibility of the materials in dental implants is assessed by the interactions between the implant and the tissue and is used as a measure for osseointegration.

The other factors associated with implant success in all loading protocols identified in the literature include biomaterial composition, implant design, biochemical factors, surface characteristics and bone quantity and quality, surgical technique and the medical status of the patient which is described below in Table 1.⁴⁻⁵

Three different types of surgical implant loading systems used and described include:

- i. *Immediate loading (IL)*: designated as the process whereby a prosthesis is attached to the implant within **24 hours** and it is a one stage surgical procedure,⁶⁻⁸
- ii) *Early loading (EL)*: referred to as the loading time when a prosthesis is attached within the **1 week** and 2 months after implant placement,⁹⁻¹⁰ and
- iii) *Conventional or Delayed loading (CL or DL)*: which differs from both immediate and early loading as the prosthesis is only attached after a healing period of **3-6 months**.^{6, 11}

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1. Dr CE. Palanyandi – Contributed to Conception, Protocol, Data collection and Analysis and Manuscript preparation and manuscript finalization (65%)
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Table 1: Factors associated with implant success in all loading protocols

Bicompatability properties	Individual reasons related to biocompatibility that impact success of implants
Bio materials	Titanium and bio-ceramic materials are widely and commonly used in fabrication of dental implants due to its high compatibility with hard tissue and living bone, titanium has a sufficient amount of strength and stiffness
Implant design	Length and diameter - influences stress distribution at the bone implant interface, Implant diameter is based on bone quality and quantity to achieve optimal stability, this is also important for stress distribution. Geometry of the influences the interaction between bone and the implant, the surface area, distribution of forces to the bone and stability. Thread of the has an influence on primary stability, enlarges implant surface area, aids in distributing forces evenly and increases the surface area at the bone implant interface
Biochemical factors	Dental implants are anchored in the bone by mechanical interlocking, fibro-osseous retention and osseointegration, mechanical interlocking is associated with implant shape, surface irregularities and roughness, holes or grooves and thread type and number
Surface characteristics	When a material is placed in the body, a biological response will be mediated by the interaction of the implant through its surface. When cells and biomaterials meet, information is exchanged leading to remodeling and activation of specific genes. The first response is the absorption of specific proteins, lipids, ions and sugars allowing activation of cell mechanisms to either accept or reject the implant by determining which and what number of cells will populate the surface. A high percentage of bone to implant contact is necessary to create sufficient anchorage of the implant which is required for osseointegration.
Bone quality and quantity	Bone quality- structural and mineral content affects success or failure of an implant, success rate of the implant is thought to be dependant on the volume quality of surrounding bone. Bone quantity-this is related to bone density Knowing the type of bone present in the maxilla or mandible aids in a better understanding of bone quality or quantity. This is important when planning a treatment strategy
Surgical technique	Surgical techniques should enhance primary stability of the implants. In order to minimize sacrificing bone the osteotome technique was introduced, piezoelectric bone surgery claims to be superior to conventional surgical methods as this surgery suggests improved precision, selective cutting action, minimal damage to the nerves and blood vessels, reduced bleeding and absence of overheating.
Medical status	Healthier patients will tend to have a higher success rate and certain conditions may increase or exacerbate failure of implant treatment.

Patients view conventional loading as a disadvantage as treatment time is extended and patient discomfort is prolonged. Conventional loading is indicated dependent on the quality and quantity of bone, the number of implants required, the length of the implant and insertion value as this affects primary stability which is a measure of implant success it is also based on what the clinician decides is the best treatment strategy. It is a two-stage technique and the rationale for conventional loading is to ensure that the implant remains in an undisturbed environment throughout the healing phase.¹²

The structural and functional connection between the implant and bone, once loaded, is a measure of osseointegration.⁵ Osseointegration is the process of attachment of implants placed in bone, irrespective of the loading system used, and is defined as the direct connection of living bone with the surface of an implant subjected to a functional load. It is a time dependent healing process where clinically asymptomatic rigid fixation of alloplastic materials is achieved and maintained.¹³

Stability of implants are addressed on 3 different levels:

- Primary stability, which is dependent on mechanical engagement with compact bone is a key factor in the success when using the IL system,
- Secondary stability offers biological stability through bone regeneration and remodeling and,
- Tertiary stability is discussed as the maintenance of osseointegration.^{11, 14}

Prosthetic factors for implant success are dependent on osseointegrated dental implants providing a stable base for restoration of function and esthetics in completely edentulous patients.¹⁵

Implant stability may be quantified which makes determining this outcome measurable. The insertion torque value (ITV) of implants, the resonance frequency analysis (RFA), and implant stability quotient (ISQ) measures different aspects of stability. ISQ measures the axial stability and ITV measures rotational stability of implants, and together these factors aid a better understanding of primary stability.¹⁶

Implant success rate ranges between 92-98% and implant loss ranges between 1-10% (56,57,58) but it is important to be aware of the types of complications which may occur with treatment and how the different forms of treatment or loading systems impact on this. Implant treatments, irrespective of which loading systems are used, are expensive procedures. Thus, failure of these can be very disheartening for the patient. Practitioners must therefore ensure patients are offered the treatment procedures with the best outcomes for placing implants. Therefore, the aim of this scoping review (ScR) was to compare immediate and early with conventional dental implant loading when a fixed or removable prosthesis is placed to assess which implant system is superior to the other independent on the occlusal scheme.

METHODOLOGY

This ScR was conducted using the adapted version of the Arksey and O'Malley six step framework which includes identifying the research question, searching for relevant studies, selecting the studies, charting the data, collating, summarizing, and reporting the results and consultation.¹⁷

Identification of the research question

The research question for this scoping review was as follows:

How do the procedures of immediate and early compare with conventional dental implant loading that is used on adults requiring implants for fixed or removable prostheses?

This question was formulated using the following guidelines:¹⁸

- Population (P)- refers to the adult patient requiring implants,
- Concept (C)- the dental implant loading protocol (immediate and early vs conventional) and
- Context (C)- implants placed in the maxillary and/ or the mandibular arches globally.

The outcomes for the ScR were divided into:

- primary which compares immediate and early to conventional dental implant loading
- secondary which investigates implant stability, bone quality and quantity, marginal bone loss, clinical parameters, and patient satisfaction.

Identifying the relevant studies

A search strategy was developed and used in the following online databases PubMed, Elsevier , Springer, Wiley, Cochrane library and Academia. Keyword combinations and

synonyms using Boolean operators were used to develop the following broad search strategy:

(Conventional implant loading OR delayed implant loading) AND (early implant loading) AND (immediate implant loading) AND (removable prostheses OR dentures) AND (fixed dental prothesis OR single crowns OR bridges) AND (marginal bone loss OR esthetics OR patient satisfaction OR bone quality OR bone quantity) AND (2002- June 2024).

Study selection

A 3-step screening process was utilized where titles and abstracts were initially screened independently by the two reviewers (CP and SK) and the relevant articles identified and included for full review. Mendeley, a reference management application system, was used for these steps: relevant articles were exported from databases and saved. Then, following the necessary steps, duplicates were eliminated via Mendeley, and abstracts and full text articles reviewed for inclusion.

With reference to the inclusion/ exclusion criteria set for this ScR, articles published in English during the period 2002-2024 and with different study designs (randomized or non-randomized controlled trials, surveys or observational studies) were considered. In addition, adult patients receiving a fixed or removable prosthesis with implants were included. All animal studies were excluded from this scoping review.

Charting the data

The principal researcher charted the data following the inclusion criteria from the included articles and based it on the source (authors, country, date published), methods (sample

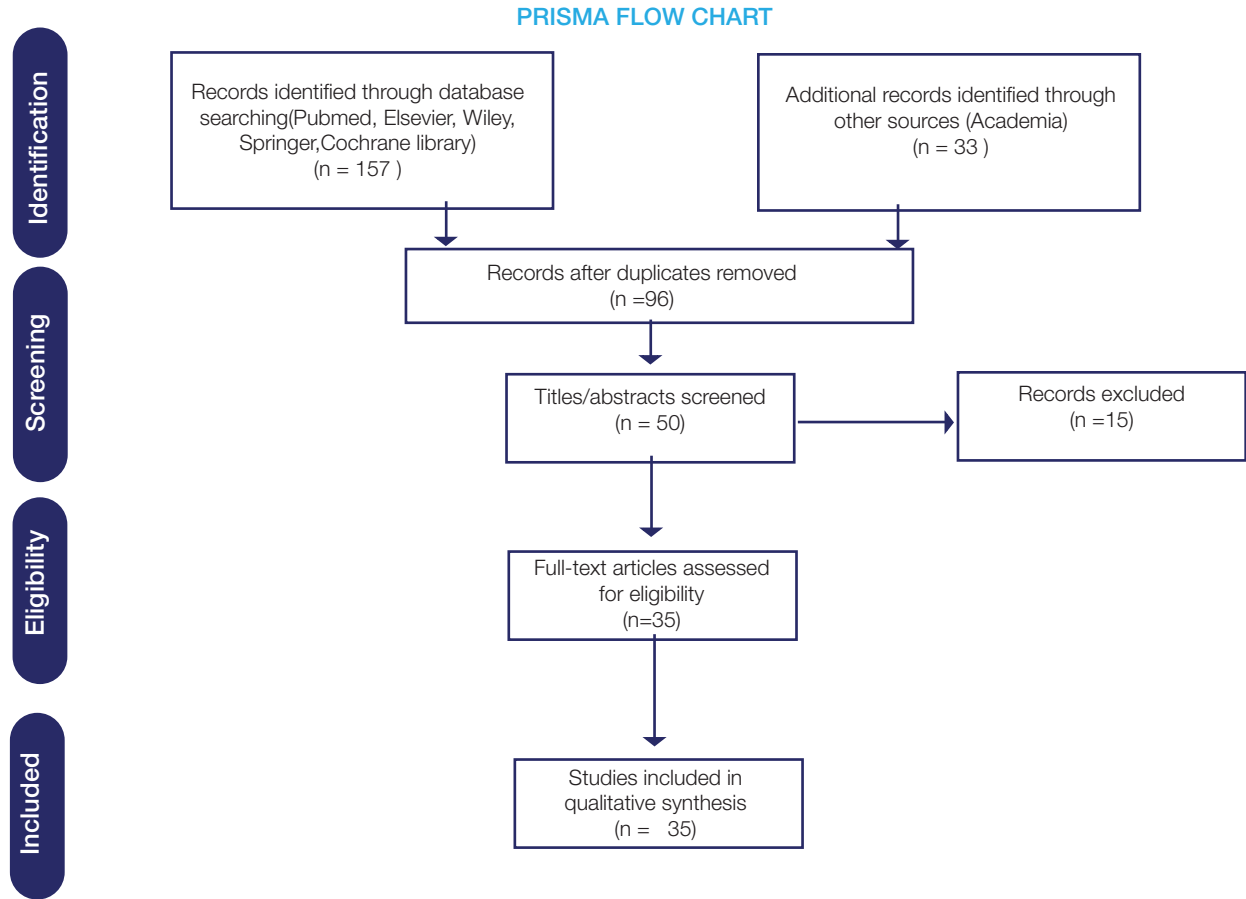


Figure 1: PRISMA Flow chart of database searches for the Scoping Review

Table 2: Characteristics of included studies

Study details	Method	Sample size	Number of implants placed	Maxilla or mandible
Author, year,				
Papaspyridakos P, Chun-Jung C et al, 2014	Systematic review and meta-analysis	62 studies ,8 on early loading, 45 on immediate loading, 11 on conventional loading	2695	Maxilla and mandible
Windael S, Vervaeke S et al, 2018	Prospective clinical study	21 patients	105 placed with immediate loading	Mandible
Weerapong K, Sirimongkolwattana S et al, 2018	Randomized clinical trial (RCT)	46 patients	46 implants placed , 23 short implants and 23 conventional implants	Mandible
Kern M, Att W et al, 2018	RCT	158 patients	81 immediate loading, 77 conventional loading	Mandible
Benic GI, Mir-Mari J et al, 2014	Systematic review and meta-analysis	10 RCT comparing immediate and conventional loading and 1 comparing immediate and early loading	597	Maxilla and mandible
Kutkut A, Rez M et al, 2019	RCT	20	40 implant placed, 20 immediate loading and 20 conventional loading	Mandible
Kim HS, Cho HA et al, 2018	Retrospective study	52 patients	370 implants placed	Maxilla and mandible
Ter Gunne LP, Dikkes B et al, 2016	Prospective randomized clinical trial	26 patients	26 implants placed, 15 immediate loading and 11 early loading	Mandible
Alfadda SA, Chvartszaid, et al, 2019	RCT	42 patients	not specified but patients were divided into 20 for immediate loading and 22 for conventional loading	Mandible
Koirala DP, Singh SV, et al, 2016	Pilot comparative clinical study	80	not specified but patients were divided into 40 immediate loading and 40 conventional loading	Mandible
Nicolau P, Guerra F et al, 2018,	RCT	56 patients	72 implants, 33 immediate loading and 39 early loading	Maxilla and mandible
Salman A, Thacker S et al, 2019	RCT	23	not specified but patients were divided into 12 for immediate loading and 11 for conventional loading	Mandible
Cordaro L, Torsello F et al, 2009	Systematic review	19 articles, 9 on immediate loading , 8 on early loading and 2 comparing immediate and early loading		Mandible
Schwarz S, Sanz-Martin et al, 2016	Review , consensus report	2 systematic reviews used	not specified	Maxilla and mandible
Reis R, Nicolau P et al, 2019	RCT	24 patients	48 implants placed	Residual mandibular ridge
Helmy MHED, Alqutaibi AY et al, 2017	Systematic review and meta-analysis	7 Rct's were used	336 implants, collective number from all the RCT'S	Mandible
Kokovic V, Jung R et al, 2014	RCT	12	72 self-tapping implants placed	Mandible
Barewal R, Stanford C et al, 2012	RCT	40 patients	40 implants placed	Maxilla and mandible

Table 2: continued

Study details	Method	Sample size	Number of implants placed	Maxilla or mandible
Raghoobar G, Friberg B et al, 2003	Prospective multicentre clinical trial	83 patients	170 implants placed	Mandible
De Smet E, Duyck J et al, 2007	Prospective clinical trial	30	50 implants placed	Mandible
Schrott A, Riggi-Heiniger M et al, 2014	Systematic review and meta-analysis	24 publications used		Mandible
Schimmel M, Srinivasan M et al, 2014	Systematic review and meta-analysis	58 studies used		Maxilla or mandible
Strietzel FP, Karmon B et al, 2011	Retrospective study	25 patients	283 implants placed	Maxilla and mandible
Jokstad A, Alkumru, 2013	RCT	35 patients	140 implants placed	Mandible
Alsabeeha N, Atieh M et al, 2010	Systematic review and meta-analysis	10 studies used		Mandible
Moraschini V, Porto Barboza E, 2015	Meta- analysis of RCT	27 articles used		Mandible
Yildiz P, Zortuk M et al, 2018	RCT	33 patients	18 implants placed	Maxilla
Abunabi A, Morris M et al, 2019	Systematic review	4 trials used		Maxilla
Zhang S, Wang S et al, 2017	Meta- analysis	29 studies used		Maxilla and mandible
Huynh-Ba g, Oates TW, et al, 2018	Systematic review	9 studies used		Maxilla or mandible and partially edentulous areas
Sanz- Sanchez I, Sanz-Martin I et al, 2014	Systematic review			Maxilla or mandible
Dos Reis RJ, Calha N et al, 2019	RCT	24		Mandible
Atieh MA, Atieh AH et al, 2009	Systematic review and meta-analysis	5 trials		Maxilla or mandible
Zembic A, Glauser R et al, 2009	RCT	11 patients	51 implants placed	Maxilla or mandible
Nkenke E, Fenner M, 2006	Review of literature	38 papers		Maxilla and the mandible

size, study designs), study details (number of implants, implant system, location of the implant, implant length type of fixed/ removable prosthesis), participant information, study outcomes, conclusion and limitations.

Collating, summarizing, and reporting the result

Themes, identified from the literature were created and results of the ScR synthesized accordingly and the outcomes were narratively reported.

Results

Ethics approval was obtained from the institutional ethics board, where it was considered as a low risk study (BMREC No: BM20/1/6).

Demographics of included publications

The databases search identified 118 pubmed, 15 Elsevier, 16 Wiley, 7 Springer, 33 Academia and 1 from the Cochrane library which resulted in 190 records. Once duplications (N=94) were eliminated using Mendeley, the remaining 96 records' titles and abstracts were screened further using criteria set

for inclusion. After elimination of the studies that did not meet the inclusion criteria, only 35 full-text records were identified as eligible for this ScR (Figure 1).

Characteristics of Included studies (Table 2)

Studies investigating the success and comparability of the different implant loading systems were conducted in different parts of the world as seen with all included studies. All included studies are tabulated in Table 2. Most studies (N=27) were completed in 1st world countries where implants are placed more often, and only one study was conducted in Africa.¹⁹ The study designs for the included studies were varied, indicating the differing qualities of research completed. Some were primary research studies for example, randomized controlled clinical trials (RCT) (N=14).^{9, 14, 16, 20-37}

Others were secondary studies, such as systematic reviews (SR) (N=7),^{1,10, 19, 38-41} and 3 were SRs with a meta-analysis,⁴²⁻⁴⁴ 1 had completed a meta-analysis only,⁴⁵ and 2 unstructured reviews of the literature were also included.⁴⁶⁻⁴⁷

The sample sizes varied per study in terms of number of patients, number of implants placed per jaw and number of jaws that were included in the study. Only 2 studies investigated placement of implants in the maxilla, and a few where implants were placed in both the mandible and maxilla (N=13).^{10,16,25,29,33-34,37,40-42,44-45,47} The majority (N=20) of records, however, discussed implants placed in the mandible only.^{9,14,19,20-24,27-28,30-32,35-36,38-39,43,46}

Outcomes of Included studies (Tables 3 and 4)

The outcomes are presented in themes which were decided based on information deemed most relevant to the subject at hand. These themes focused on all 3 dental loading protocols and factors contributing to implant success (implant stability, bone quality and quantity, marginal bone loss), patient satisfaction and esthetic outcomes. Results are tabulated into two decades (Tables 3 and 4). Table three includes outcomes from 2002- 2012 and table four includes outcomes from 2013-2024.

Table 3: Outcomes of the included studies for the period 2002-2012

Study details	Author country affiliation	Aims/objectives	Outcomes
Author, year,			
Cordaro L, Torsello F et al, 2009	Italy	Evaluating the predictability of EL and IL in the posterior mandible	Positive outcome: IL good survival rates
Barewal R, Stanford C et al, 2012	Iowa	Comparing stability of dental implants placed IL, EL and CL.	Positive outcome: IL, EL , CL no difference in bone level, minimum ITV and ISQ required,
Raghoebar G, Friberg B et al, 2003	Sweden	Implant survival and peri-implant conditions around endosseous implants inserted in one stage surgery	Positive outcome: implant survival. Patient satisfaction:good function and esthetic.
De Smet E, Duyck J et al, 2007	Belgium	Implant outcome of IL, EL and CL/DL of implants in the edentulous mandible	Positive outcome: EL comparable to CL, good survival rate
Strietzel FP, Karmon B et al, 2011	Berlin, Germany	Treatment of implant prosthetic rehabilitation with implants in the edentulous maxilla and mandible in IL with fixed prosthesis.	Positive outcome: IL good survival rates
Alsabeeha N, Atieh M et al, 2010	New Zealand	Evaluate evidence of all randomized and non-randomized trials comparing IL, EL and CL protocols for mandibular implant over-dentures.	Positive outcome: Implant survival
Abunabi A, Morris M et al, 2019	Brazil	Comparing IL vs EL AND DL on implant supported maxillary complete dentures	Patient satisfaction: chewing, swallowing, ease of OH, esthetics, OHRQoL, BOP, Plaque and probing depth, Implant success, Prosthesis success and survival Negative outcomes: marginal bone loss, occurrence of mucositis and peri-implantitis Biomechanical complications: screws loosening or fractured prosthetic components.
Zembic A, Glauser R et al, 2009	Switzerland	Testing whether IL implants exhibit the same survival and complication rates as EL implants.	Positive outcome: Implant survival rates
Nkenke E, Fenner M,2006	Germany	Comparing implant survival and success rates for IL and CL implants based on the highest level of evidence for these 2 clinical approaches.	Positive outcome: Implant survival and success

Table 4: Outcomes of included studies for the period 2013-2024

Study details	Author country affiliation	Aims/objectives	Outcomes
Author, year,			
Papaspyridakos P, Chun-Jung C et al, 2014	Boston	Investigate effect IL compared to EL and CL with fixed implant prosthesis	Positive outcome: IL implant success compared to EL and CL.
Windael S, Vervaeke S et al, 2018	Belgium	Long term clinical outcome of IL in an edentulous mandible	Positive outcome: IL high implant survival after 10 years
Weerapong K, Sirimongkolwattana S et al, 2018	Thailand	Compare IL of short implants (6mm) and standard implants(10mm) in a single md molar tooth	Positive outcome: IL of short implants comparable to conventional length implants, implant survival
Kern M, Att W et al, 2018	Germany	Investigate the survival of a single implant in the edentulous mandible retained by a complete denture and that it is not compromised by IL	Negative outcome: IL lower survival rate after 2 years with single midline implants. Positive outcome: CL better survival
Benic GI, Mir-Mari J et al, 2014	Switzerland	IL single crowns renders different clinical results to EL and CL with respect to primary stability, marginal bone loss, stability of peri-implant survival rate, esthetics and patient satisfaction.	Positive outcome: IL and CL implant survival, minimal marginal bone loss, no effect on papilla level. Patient satisfaction: good esthetics
Kutkut A, Rez M et al, 2019	Kentucky	Comparing survival of implants IL with mandibular overdenture using 2 locator attachments vs DL, clinically and radiographically comparing peri-implant response around implants IL vs DL with mandibular complete over dentures.	Positive outcome: implant survival, implant stability, ISQ, minimal marginal bone loss, keratinized mucosa, modified GI and PI,
Kim HS, Cho HA et al, 2018	Korea	Evaluate full arch rehabilitation of patients with IL implants assessing cumulative implant survival rate, risk factors for implant failure and patient satisfaction.	Positive outcome: implant survival good with IL and CL after 7 years. Patient satisfaction: chewing ability, esthetics
Ter Gunne LP, Dikkes B et al, 2016	Amsterdam	Compare clinical and radiographic outcomes between EL and IL implants in support of mandibular over dentures.	Positive outcome: IL comparable to CL, implant. survival. Technical outcome: prosthesis survival.
Alfadda SA, Chvartzaid, et al, 2019	Toronto, Canada	The long term prognosis and complications of 4 IL and CL implants for mandibular fixed prosthesis, assess peri-implant changes in bone level	Positive outcome: IL comparable to CL after 10 years, implant survival
Koirala DP, Singh SV, et al, 2016	India	Evaluate and compare clinical outcomes of IL implants with CL implants using the EL protocol	Positive outcome: implant success.
Nicolau P, Guerra F et al, 2018,	Portugal	Measuring change of crestal bone level on day of surgery and 10 years in the IL and EL group. Evaluate implant survival after 10 years between the maxilla and the mandible	Positive outcomes: IL and EL good long term results, survival rates high for IL and EL
Salman A, Thacker S et al, 2019	Connecticut	Evaluate radiographic bone level change between IL and DL two unsplinted implants supporting a locator-retained mandibular over denture, compare implant survival rates, prosthetic outcomes and clinical parameters between the two groups.	Positive outcome: IL and CL showed comparable results after 5 years

Table 4: Continued

Study details	Author country affiliation	Aims/objectives	Outcomes
Author, year,			
Cordaro L, Torsello F et al, 2009	Italy	Evaluating the predictability of EL and IL in the posterior mandible	Positive outcome: IL good survival rates
Schwarz S, Sanz-Martin et al, 2016	Spain, Germany, Switerland	To critically asses evidence on clinical outcomes of IL vs CL in the edentulous region	Positive outcome:IL and CL good survival rates. Biomechanical complication: implant location, type of restoration and number of implants can influence implant loss.
Reis R, Nicolau P et al, 2019	Portugal	Comparing clinical and radiographic clinical outcomes of IL vs EL with two splintered narrow diameter implants for mandibular over dentures in residual ridges	Positive outcome: implant survival in IL and EL after 3 years. Negative outcome: crestal bone level changes after 3 years
Helmy MH, Alqutaibi AY et al, 2017	Egypt	Evaluating the similarity between IL and EL protocols and if they have similar outcomes related to implant failure and peri-implant marginal bone loss in patients requiring unsplinted two implant supported over dentures.	Positive outcome:IL and CL good suvival rates
Kokovic V, Jung R et al, 2014	Zurich	Comparing IL and EL clinical results of self tapping implants in the posterior mandible	Postitive outcome : implant survival, minimal marginal bone loss
Schrott A, Riggi-Heiniger M et al, 2014	Boston	Present, analyze and summarize clinical and scientific evidence in partially edentulous patients with extended edentulous sites, identify criteria associated with loading protocols.	Positive outcome: IL comparable to EL and CL, good survival rates, minimum ISQ, ITV required
Schimmel M, Srinivasan M et al, 2014	Switerland	Testing the hypothesis that IL protocol for implant supported over dentures shows 1 year survival rates similar to that of EL and CL.	Postive outcome: implant survival.
Jokstad A, Alkumru, 2013	Norway, Canada	Appraise clinical outcomes following loading of 4 implants in the mental foramina area in the mandible with a full- arch fixed dental prosthesis converted from the pre-existing denture of the patient with IL	Positive outcome:IL good survival rate. Biomechanical outcome: full arch fixed dental prosthesis converted from pre-existing denture showed good results after 5 years
Moraschini V, Porto Barboza E, 2015	Brazil	Comparing implant survival, marginal bone loss, any complications of IL and CL of single implants inserted in the posterior mandible.	Positive outcome: implant survival. Negative outcome: marginal bone loss.
Yildiz P, Zortuk M et alm 2018	Turkey	Comparing pink esthetic score (PES) outcomes after 1 year follow -up of IL and LL/CL after implant restoration of a single tooth in the anterior maxilla.	Patient satisfaction: IL and CL good esthetics
Abunabi A, Morris M et al, 2019	Brazil	Comparing IL vs EL AND DL on implant supported maxillary complete dentures	Patient satisfaction: chewing, swallowing, ease of OH, esthetics, OHRQoL, BOP, Plaque and probing depth, Implant success, Prosthesis success and survival Negative outcomes: marginal bone loss, occurrence of mucositis and peri-implantitis Biomechanical complications: screws loosening or fractured prosthetic components.

Table 4: Continued

Study details	Author country affiliation	Aims/objectives	Outcomes
Author, year,			
Zhang S, Wang S et al, 2017	China	Compare clinical and radiographic outcomes between IL, EL and CL using indexes implant failure rate, marginal bone levels and changes and ISQ. Investigate impact of loading protocols CL and EL, implant locations, implant number per patient, type of prostheses, loading concept and follow-up time meta-analysis.	Positive outcome: implant success
Huynh-Ba g, Oates TW, et al, 2018	Texas, Baltimore	Comparing IL, EL and CL in terms of patient reported outcomes	Patient satisfaction: IL positive impact on oral health related quality of life
Sanz- Sanchez I, et al, 2014	Spain	Assess if IL achieves comparable clinical outcomes when compared to CL depending on the type of restoration used to rehabilitate the edentulous area.	Negative outcomes: IL implant failure was greater than compared to CL, IL less crestal bone resorption during healing. Positive outcome: implants survival was still good. Patient satisfaction: IL improved function and comfort
Dos Reis RJ, Calha N et al, 2019	Portugal	Comparing radiographic and clinical outcome of IL and EL with two-splinted narrow-diameter implants for mandibular implant over-dentures in a thin non-augmented residual ridge	Positive outcome: IL and EL good implant survival rates after 3 years

1. Dental loading protocols and implant success

The articles (N=35) included for this ScR compared IL to CL/ DL, EL to CL/ DL and all three (IL, EL, CL) loading protocols to understand what factors contribute to the success of implants placement and the method used to do this. A systematic review conducted by Abdunabi *et al*, 2019 compared IL to EL and CL on an implanted supported maxillary complete denture.¹ This SR found that the IL system is as effective as the EL and the CL ones. There was no difference in survival rates of the implants or the prosthesis.

Results from 2 different RCTs with a follow-up period of 10 years, indicated similar results as the study by Abdunabi *et al* (2019). The 1st RCT compared IL to CL of a mandibular implant supported fixed prosthesis and reported no differences between these 2 implant loading protocols.²² In this RCT, an insertion torque of >35Ncm to achieve primary stability was highlighted, thus 4 implants were placed to support the mandibular prosthesis. The 2nd RCT, by Nicolau *et al*, (2018), determined long-term performance of chemically modified sandblasted, large-grit and acid etched surface (SLActive) implants following IL or EL protocols in the posterior maxilla or mandible. It was reported that there was a high implant survival rate and total change in crestal bone level (from -1.05±1.06mm) between delivery and final prosthesis after the 10-year follow-up.

A 3-year follow-up study conducted by Ter Gunne *et al* (2018) compared clinical as well as radiographic outcomes between IL and CL implants in the support of a mandibular overdenture.⁹ Implant stability was good and insertion torque of 35 Ncm was achieved, no prosthesis was lost, no prosthetic complications reported and the mean bone loss was 0.35±0.63mm for IL and 0.31±0.96mm for CL.⁹

Cordaro *et al*. conducted a systematic review evaluating the predictability of immediate loading (IL) and early loading (EL) protocols in the posterior mandible. The findings support the use of IL and EL protocols with microroughened dental implants in partially edentulous posterior mandibles, provided that modifying risk factors are absent. Clinical outcomes suggest that both protocols are viable within a 6–8 week healing period and can be applied successfully in most posterior mandibular cases, whether for single crowns or fixed dental prostheses. The review further reported no significant changes in peri-implant bone levels, indicating predictable stability of the peri-implant environment when these protocols are followed [46].

2. Clinical factors contributing to implant success

Factors contributing to implant success included primary stability, insertion torque, marginal bone loss, the number of implants inserted and the arch location of the implants. An implant stability quotient (ISQ) clinically ranging between 55–80 is an indication of implant stability.^{23,49–50} A study conducted by Kim *et al*, 2018 evaluated cumulative survival rate (CSR) looking at risk factors for implant survival and patient satisfaction.³³ The 7-year CSR was 0.989 for IL and 0.986 for DL.³³ This study indicated that the differences in CSR was dependant on the length of the implant making it the key factor for maximum strength for primary stability.³³

It was also identified that the ITV had to be within the range of 20–35Ncm for initial primary stability, to allow a stable platform for a prosthesis whether fixed or removable.^{21–22,35} This ITV and RFA gives a clinical, non-invasive measurement of implant and bone stiffness.^{16,48}

In terms of marginal bone loss, included studies indicated that although there is a minor discrepancy there is no

statistically significant difference between IL and CL implant systems.^{1,32,39} Mean marginal bone loss after 3 years was found to be 0.22mm, whilst the mean ITV at implant placement differed according to the bone type:

- Type 1 bone is when bone is homogenous with very thick cortical bone and
- Type 2 bone has a thick layer of cortical bone that surrounds a core of dense trabeculae bone and the ITV for both these types were 32Ncm,
- Type 3 bone is described as having a thin layer of cortical bone with dense trabeculae bone and has good strength its ITV is recorded as 17Ncm which is half the previous types whilst,
- Type 4 bone has very thin cortical bone with low-density trabecular bone and is of poor strength with the lowest ITV at 10Ncm.¹⁶

This showed a significant difference in bone loss and that ITV is a good objective measure for bone type. The ITV for bone types 1 and 2 fit well within the recommended range and thus meet the standard required. Ideally, however, these bone types should also have a RFA of 60 before an implant is recommended to be placed.^{1,16,32,39} The initial high ITV preferred was >35Ncm and an ISQ value of > 60 before considering an implant for IL to EL protocols.^{1,16,32,39} It was also found that an ITV of 20 Ncm may be an important threshold determinant in IL of single tooth implants in the posterior region.¹⁶

3. Patient satisfaction and esthetics

The parameters used to assess patient satisfaction was comfort, esthetics, functionality and the ability to taste. A study by (Kim *et al*, 2018) evaluated implant success and patient satisfaction of IL systems in completely edentulous arches.³³ It was found that only the length of the implant affected the implant failure rate and that after 1.5 -7 years after implant placement, patient satisfaction was still high.³³ Similarly, 2 other studies investigated patient satisfaction was reported that patients preferred a fixed functional denture and IL was more satisfying than EL.^{1,40} IL and immediate placement in a single tooth edentulous space seems to have a positive impact and these studies concluded that protocol selection is based on what the patients' preference is as well as the practitioner's skills.¹ A study by Nicolau *et al*, 2018 found patient satisfaction was high for both IL and EL.²⁵ A retrospective study by Kim *et al*, 2018 did not only evaluate CSR but patient satisfaction and it was found that irrespective of the length of time following implant placement, there was a high degree of patient satisfaction for both IL and CL.³³

Yildez, P *et al*, (2018) evaluated patient esthetics after 1 year with a small study sample (N=33) and compared IL (N=18 implants) to CL (N=15 implants) systems.²⁶ The pink esthetic score (PES) was determined, and it was found that there was no significant difference with these values between the IL and CL groups.²⁶ This was an indication that IL does not have a negative effect on the esthetics.²⁶

DISCUSSION

The research question for this scoping review was to compare immediate and early to conventional dental loading and the supporting evidence/ outcomes were quite clear about these being comparable. Findings observed in this review mirrors previous studies which examined the success of immediate and conventional dental implant loadings. Similarities were

reported by the different researchers regarding the success of IL and CL or DL loading protocols.^{21-22,27,41,44,51}

This Scoping Review (ScR) provided evidence that immediate, early, and conventional dental implant loading are all viable treatment options. This finding aligns with the existing literature on implant success and highlights key contributing factors, including implant design, the number of implants placed, biomechanical considerations, surface characteristics, and the quality and quantity of the bone, all of which play a critical role in treatment outcomes.^{4-5,52-53}

Critical factors such as primary stability, implant stability quotient, bone quality and quantity in either dental arch, marginal bone loss, implant design and number of implants were identified as necessary for the survival and success of implants. Marginal bone loss (MBL) was included in the investigations for both IL and CL dental implants systems and recorded as a measurement of success. The outcomes of included studies were in agreement with these outcomes of stability and provided guidelines such as the range and values for ITV, RFA and ISQ to gauge for placing implants using IL and EL systems.^{21-23,35,49-50} Other researchers were also in agreement with these findings, indicating that if IL implants are placed, and primary stability or the ITV is greater than 30Ncm, success rates could be as excellent as 95%.²²

Primary stability is highlighted by several researchers as the single most important factor relating to the success of the implant. This is in agreement with the evidence that states, to achieve optimal osseointegration functional loading should be done on an immobile implant, to determine primary stability in immediate dental loading.⁵⁴ Similarly, Yildiz *et al*, 2018 found no differences in IL and CL regarding esthetics and suggested that immediate non-occlusal loading should be performed according to a specific protocol with attention to primary stability.²⁶

Even though these two protocols showed that they are comparable, results of a study conducted by Kern *et al*, 2018 indicated that CL of dental implants is still the most used and offered dental loading protocol.²⁰ This is mostly due to the fact CL has been studied more extensively and more research is available with this treatment protocol, and it is also not as demanding a procedure as the IL system.^{20,46} There was only one study indicating that failure with IL was greater than with CL.⁴¹

Regarding surface characteristics of an implant evidence supports loading of microroughened dental implants in the partially edentulous posterior mandible at 6-8 weeks in the absence of factors such as fresh extraction sockets, guided bone regeneration and short implants.⁴⁶ Authors suggested that loading within 6-8 weeks could be considered for a majority of clinical situations in the posterior mandible with either single crowns or fixed dental prosthesis, making the IL system a viable option.⁴⁶ Their evidence also suggests that chemically modified surfaces of an implant loaded within 4-5 weeks shows a good survival rate regardless of the type of bone it is placed in, again favoring a IL system.⁴⁶ Marginal bone loss was considered comparable in IL and CL or DL dental implant systems indicated via the radiographic analysis.^{21,16,46}

Differences in CSR is dependent on the length of the implant which is associated with a higher survival rate and

it is a measure of a reduction in bone stress irrespective of bone quality, but improving stability and thus success of implants placed.³³ This outcomes definitely impacts on patients' satisfaction, regardless of age, length of implant or loading system used. It is suggested that a patient-centered treatment approach be adopted as these are measures of patient satisfaction and aesthetics. These should be evaluated together with implant survival rate, marginal bone loss and peri-implant tissue responses.³³

CONCLUSION

Immediate, early and conventional dental loading can be used as successful and viable treatment options. Survival and success rates, marginal bone loss, esthetics and patient satisfaction are similar and comparable in immediate, early and conventional dental implant loading whether there is a fixed or a removal prosthesis. Even though the literature span is over two decades there are no significant differences.

Limitations

- The literature for this scoping review was conducted between 2002-2024 so very little primary research was conducted and available thus a true measure of IL or EL systems outcomes were not available.
- These studies used standard radiographs to measure marginal bone loss and no other advanced measurement such as Cone beam computed tomography (CBCT) was used. This could have affected the results provide with marginal bone loss.
- Even though studies spoke briefly on the medical status of patients, there was evidence lacking on how this affects the success of implants placed and the different protocols as discussed. Certain medical conditions can affect the periodontium which could in effect affect the prognosis of the implant. Newer literature speaks a lot more what the long effect could be on the survival of the implant itself.
- There are not many long-term follow-up studies (10 years or more), which could provide stronger evidence related to the success of implants or assessing factors such marginal bone loss possibly differing over time and assessing peri-implant soft tissue not just after 12 months. It is therefore suggested the short-term study results be interpreted with caution. Newer literature has a few more long term studies but is based more in immediate and conventional dental loading specifically.
- Some of the sample sizes were small, or poorly reported and as such resulted in a cautious approach to interpreting the results.

Recommendations

- Primary research investigating and producing new knowledge related to IL and EL systems.
- Comparing marginal bone on standard radiographs and CBCT.
- Conducting studies with larger samples and over a longer period and with clinical application.
- Addressing more studies possibly based on the occlusal scheme.

AUTHORSHIP

CP: Contributed to Conception, Protocol, Data collection and Analysis and Manuscript preparation and manuscript finalization (65%)

SK: Contributed to Protocol, Data Analysis and Manuscript preparation and manuscript finalization (35%)

CONFLICT OF INTEREST

The authors declare no conflict of interest

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DATA AVAILABILITY STATEMENT

1. The datasets generated during and/or analysed during the current study are available from the corresponding authors on reasonable request.
2. Data generated or analysed during this study are included in this published article.

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CPD questionnaire on page 216

The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.

