Combination Syndrome in Patients with Mandibular Implant Supported Overdenture and Conventional Maxillary Denture - A Systematic Review

Keywords

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ABSTRACT

Objectives: Implant-supported mandibular dentures are increasingly preferred for edentulous mandibles due to their superior function, stability, and patient satisfaction. However, when opposed by a conventional maxillary complete denture (CD), it remains unclear whether this configuration contributes to Combination Syndrome. This systematic review investigates the presence and clinical features of Combination Syndrome in such cases. Methods: A systematic search of Scopus, Ovid Medline, Web of Science, and Embase was conducted for studies published between 1994 and 2024. Of 133 initially identified articles, six met the inclusion criteria. These included four cohort studies, one cross-sectional study, and one randomised controlled trial, involving 141 participants. Results: Common findings included anterior maxillary bone loss, loss of posterior occlusion, and reduced retention of the maxillary denture—often linked to excessive anterior contact. Some studies reported increased ridge resorption with implant-supported overdentures, while others found no significant differences compared to conventional dentures. Conclusion: Due to the limited number and quality of available studies, no definitive conclusion can be drawn regarding the prevalence of Combination Syndrome in this prosthetic arrangement. Further well-designed clinical studies are needed to clarify its long-term implications.

INTRODUCTION

Combination Syndrome (CS), also known as anterior hyperfunction syndrome, occurs when a fully edentulous maxilla opposes natural mandibular anterior teeth[1]. This syndrome can lead to significant complications, including anterior maxillary ridge resorption, overgrowth of tuberosities, papillary hyperplasia of the hard palate, extrusion of mandibular anterior teeth, and loss of bone and ridge height beneath mandibular removable partial denture bases[1]. Such complications can jeopardize the long-term success of prosthetic treatments[2].

The reported prevalence of Combination Syndrome (CS) varies across studies: Shen and Gongloff (1989) reported a 24% prevalence of classic features[3], Bagga *et al.* (2019) found that 46.46% of their 99 participants showed at least one symptom of CS[4], and Reddy *et al.* (2016) observed a 30% prevalence with a female predominance in a larger sample of 160 patients[5]. Given the prevalence and impact of CS, it is crucial to consider its implications when selecting treatment options for edentulous patients. Implant-supported mandibular dentures have become a preferred treatment option for patients with edentulous mandibles due to their superior functionality, stability, and retention compared to conventional dentures[4,6,7]. However, when these are paired with conventional maxillary dentures, the risk of developing CS becomes a concern[8-10]. While this approach offers a cost-effective and minimally invasive solution for replacing missing teeth, the potential for CS highlights the importance of thorough treatment planning.

The phenomenon of CS in patients with implant-supported mandibular overdentures and conventional maxillary dentures has been a topic of concern among dental professionals. CS can lead to clinical complications, such as excessive occlusal load on the remaining natural anterior teeth and deteriorating support from the maxillary ridge, which significantly affects both the functional and aesthetic outcomes of the treatment [2,6]. These factors not only diminish the overall satisfaction with the prostheses but also present challenges for long-term oral health and prosthetic durability. Furthermore, these complications can compromise the prognosis of both the mandibular and maxillary arches, requiring careful treatment planning and ongoing management[6].

This systematic review was conducted to evaluate the existing evidence on CS in patients with implant-supported mandibular overdentures and conventional maxillary dentures. A comprehensive search of electronic databases including Scopus, Ovid Medline, Web of Science, and Embase was undertaken to identify relevant studies published from 1994 to 2024. By synthesizing the available evidence, this review aims to provide a clearer understanding of the prevalence, risk factors, clinical manifestations, and management strategies associated with CS in such patients.

The importance of addressing CS in the context of implant-supported mandibular overdentures cannot be overstated. With the increasing use of implant-supported prostheses, dental practitioners must be aware of the potential for developing combination syndrome-like symptoms, particularly when these overdentures are paired with conventional maxillary dentures. This review seeks to provide valuable insights into how this treatment modality affects both soft and hard tissues, as well as patient-reported outcomes, to guide better clinical decision-making. By focusing on both clinical and functional aspects, this study aims to fill gaps in current knowledge and assist dental professionals in enhancing their treatment approaches.

MATERIALS AND METHODS

Relevant literature was identified by searching through existing reviews and primary studies related to the topic. The search of related topics between 1994 to 2024, published in English was accomplished in online databases, including Scopus, Ovid Medline, Web of Science and Embase, to review the studies in the last 30 years. A systematic search of electronic databases.

SEARCH STRATEGY

The search strategy incorporated both free-text terms and controlled vocabulary (e.g., MeSH terms where applicable), using Boolean operators such as AND and OR. For example, search combinations included terms like ('bone loss' OR 'bone resorption') AND ('implant-supported denture' OR 'implant-retained overdenture') AND ('combination syndrome' OR 'anterior hyperfunction'). The strategy was adapted for each database to maximise relevant yield.

STUDY SELECTION

One hundred thirty-three primary articles were identified. Three reviewers scanned all unmasked articles, 61 duplicated articles, 42 irrelevant articles, and 3 unretrievable articles, which were excluded from the further reviewing process. Potentially relevant titles and abstracts (n=27) were provisionally included for consideration based on full-text articles obtained from online sources.

Inclusion criteria: Studies were included if they (1) investigated patients rehabilitated with implant-supported mandibular overdentures opposing conventional maxillary complete dentures, and (2) reported on one or more characteristics associated with Combination Syndrome such as anterior maxillary ridge resorption, loss of posterior occlusion, denture instability or flabby ridge formation, either clinically or radiographically. Both prospective and retrospective studies were considered if they provided data on maxillary dentoalveolar changes linked to the prosthetic configuration.

Exclusion criteria: Studies were excluded if they (1) focused solely on the success rate of mandibular implants without addressing maxillary outcomes, (2) did not report or assess any clinical or radiographic evidence of maxillary dentoalveolar changes (e.g., ridge resorption, tuberosity enlargement, flabby ridges), (3) did not involve maxillary complete dentures as antagonists, or (4) were case reports *(Figure 1)*.

QUALITY ASSESSMENT

Three reviewers independently performed a quality assessment using the Joanna Briggs Institute (JBI) critical appraisal tools tailored to each study design (e.g., cohort studies, cross-sectional studies, randomised controlled trials). Each checklist item was rated as "yes," "no," "unclear," or "not applicable." Disagreements between reviewers were resolved through

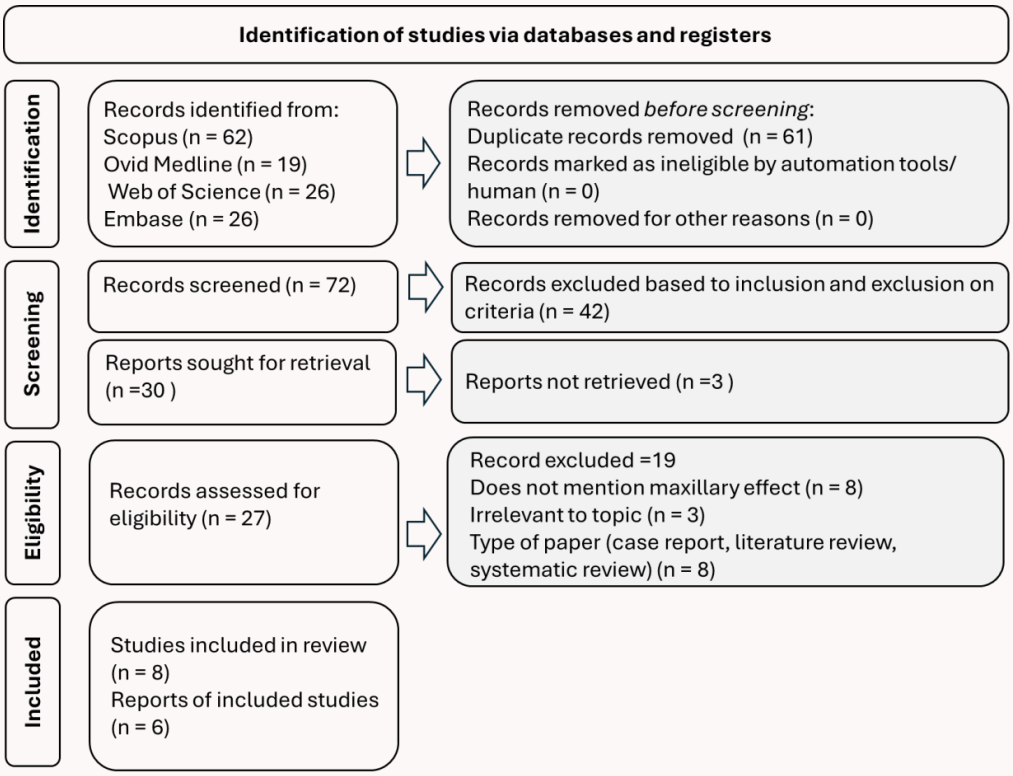

Figure 1: PRISMA flow chart, in accordance with the PRISMA 2020 statement which provides reporting guidance for systematic reviews.

discussion until consensus was reached. The final risk-of-bias assessments were used to inform the qualitative synthesis of the included studies. The appraisal process followed guidance from the JBI Manual for Evidence Synthesis[11]. *(Table 1)*

RESULTS

DATA EXTRACTION PROCESS

Variables from the selected studies were recorded to allow data extraction. The following data were recorded: year of study, study design, number of patients, age, period of prostheses wear, number and location of the implant, retention mechanism, occlusal scheme, follow-up period, method of assessment, stability, retention, support, presence of loss of posterior occlusion and maxillary bone loss.

A total of 133 studies were identified through a systematic search of databases. The details of the search and elimination of publications are summarised in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) chart[12] *(Figure 1)*.

Twenty-seven studies within the screening criteria were identified for full-text reading. Nineteen studies did not meet the inclusion criteria. The risk of biases was assessed using the JBI grades of recommendation and two more studies were excluded. The risk of bias assessment for each study included is described in Tables 1-3. Six publications (3 retrospective and 3 prospective studies) were chosen for data extraction. While the included studies varied in design, with differing levels of evidence, no quantitative synthesis was performed. Study findings were analysed qualitatively, with attention to methodological rigor and study type during interpretation.

The details from the extracted studies are summarised in Table 4. We included 4 cohort studies, 1 cross-sectional study and 1 randomised control trial, covering a total of 141 participants. Methods used to assess maxillary bone loss in the studies are clinical fit assessments, panoramic and cephalometric imaging, CBCT superimposition, and model-based ridge measurements are shown within the study summaries in Table 6. Out of the 6 publications, 3 studies directly compared mandibular implant prostheses and mandibular conventional complete dentures summarised in Table 5.

Table 1. JBI Grades of recommendation of cohort studies.

Grading of Cohort Study: JBI	Gupta et al, 1999	Mohamed A. et al, 2007	Elsyad et al, 2013	Alsrouji et al, 2018
Were the two groups similar and recruited from the same population?	Yes	Yes	Yes	Yes
Were the exposures measured similarly to assign people to both exposed and unexposed groups?	NA	Yes	Yes	Yes
Was the exposure measured in a valid and reliable way?	Yes	Yes	Yes	Yes
Were confounding factors identified?	Yes	NA	Yes	Yes
Were strategies to deal with confounding factors stated?	NA	NA	NA	NA
Were the groups/participants free of symptoms of combination syndrome at the start of the study (or at the moment of exposure)?	No	Yes	Yes	Unclear
Were the outcomes measured in a valid and reliable way?	Yes	Yes	Yes	Yes
Was the follow up time reported and sufficient to be long enough for outcomes to occur?	Yes	Yes	Yes	Yes
Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	Yes	Yes	Yes	Yes
Were strategies to address incomplete follow up utilized?	NA	NA	NA	NA
Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes
Include/ Exclude	Include	Include	Include	Include

NA – Not Applicable

Table 2. JBI Grades of recommendation of cross-sectional studies.

Grading of Cross-sectional Study: JBI	Lechner, Mammen 1996
Were the criteria for inclusion in the sample clearly defined?	Yes
Were the study subjects and the setting described in detail?	Yes
Was the exposure measured validly and reliably?	Yes
Were objective, standard criteria used for measurement of the condition?	Yes
Were confounding factors identified?	Yes
Were strategies to deal with confounding factors stated?	NA
Were the outcomes measured validly and reliably?	Yes
Was appropriate statistical analysis used?	Yes
Overall appraisal	Include

NA – Not Applicable

Maxillary bone loss was assessed through various methods in the included studies. Five studies conducted clinical examinations[10,13-17] to evaluate the fit, retention, and stability of the antagonistic maxillary complete dentures. Lechner, Mammen, and Gupta *et al*. first used a fit checker with balanced finger pressure, then repeated the test under biting pressure to compare the denture's fit during function. Radiographic analyses were also commonly employed, including Panoramic[14,15],

Table 3. JBI Grades of recommendation of randomised controlled trial.

Grading of Randomised Control Trial: JBI	Narhi et al, 2000
Bias related to selection and allocation	
Was true randomization used for assignment of participants to treatment groups?	Unclear
Was allocation to treatment groups concealed?	Unclear
Were treatment groups similar at the baseline?	Yes
Bias related to administration of intervention/exposure	
Were participants blind to treatment assignment?	Unclear
Were those delivering the treatment blind to treatment assignment?	No
Were treatment groups treated identically other than the intervention of interest?	Yes
Bias related to assessment, detection and measurement of the outcome	
Were outcome assessors blind to treatment assignment?	No
Were outcomes measured in the same way for treatment groups?	Yes
Were outcomes measured in a reliable way	Yes
Bias related to participant retention	
Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analysed?	Yes
Statistical Conclusion Validity	
Were participants analysed in the groups to which they were randomised?	Yes
Was appropriate statistical analysis used?	Yes
Was the trial design appropriate and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	Yes
Overall appraisal	Include

Cephalometric[10,13], and CBCT (Cone Beam Computed Tomography). Additionally, another method utilizing models was noted[16,18]. Alsrouji *et al.*[16] utilized CBCT imaging to create 3D models, which were superimposed using the 3-matics program (Materialise NV) to quantify and map residual ridge resorption. Narhi *et al.* used diagnostic cast models with standardized landmarks, such as the incisive papilla and scar line, measuring the ridge with a Boley gauge[18].

On one hand, two studies[10,16] indicate that mandibular implant-supported overdentures (ISO) contribute to increased anterior maxillary bone resorption, showing significantly greater residual ridge loss in the anterior maxilla[16] and increased perceived denture looseness[10]. In contrast, another study[14] suggests that mandibular complete dentures result in more pronounced annual anterior maxillary bone resorption compared to ISOs. Meanwhile, a randomised control trial by Narhi *et al.* suggests there were no significant differences in maxillary bone loss across three types of mandibular prostheses (complete dentures, ISO, and implant-mucosa-supported overdenture).

In addition, two studies[14,15] propose that ISOs, when combined with mucosal support, can lessen maxillary alveolar ridge resorption. Elsyad *et al.* elucidated this by comparing telescopic and ball implant attachments[15]. They found that the maxillary arch opposing mandibular ISOs with ball attachments exhibited significantly less flabby ridge tissue, improved denture retention, and reduced anterior maxillary bone loss[15].

DISCUSSION

Despite the limited number of eligible studies, this systematic review addresses a clinically significant and underexplored question in prosthodontics: whether implant-supported mandibular overdentures (ISO) contribute to the development of Combination Syndrome (CS) when opposed by maxillary complete dentures (CD). While the scarcity of high-quality, focused research on this topic underscores the early stage of evidence development, the clinical relevance and increasing prevalence

Table 4. Characteristics of included studies

Authors, Year	Study Design	No. of Patients	Age,y (mean,range)	Period of prostheses wear, in month	Implant (number, location)	Retention Mechanism	Occlusal scheme	Follow-up,y (range,mean)	Method	Method of Maxillary Bone Loss Assessment	Mx complete denture retention and Stability affected by ISO	Loss of posterior occlusion	Maxillary Bone Loss caused by ISO
Gupta et al, 1999	Retrospective	11 (4 males, 7 females)	65.6 (53-74)	> 21	2, NR	NR	NR	2.4-11 (5.2)	Clinical examination, Cephalometric	Clinical assessment and panoramic radiographs	Adequate retention, Adequate stability	Loss of posterior occlusion, perceived looseness	Vertical, horizontal bone loss not significant
Mohamed A. et al, 2007	Prospective	15	NR	24	2, Canine	Magnet (single abutment) vs Bar (splinted group)	NR	2	Clinical, Panoramic	Fit-checker test under finger and biting pressure	NR	NR	Significant soft tissue changes and resorption changes in bar retained ISO No significant soft tissue changes and resorption in magnet retained ISO
Elsyad et al, 2013	Retrospective	32 (21 males, 11 females)	NR	NR	2, Canine	Ball and telescopic attachments	Bilateral balanced occlusion	4	Clinical, Panoramic	Clinical examination of denture retention and stability	Retention better in ball attachment Insignificant difference in stability between ball and telescopic	NR	Telescopic attachment increased ant. ridge resorption and flabbiness
Alsrouji et al, 2018	Prospective	18 (8 male 10 females)	65 (52-70)	12	2, Canine	NR	Bilateral balanced occlusion	1	CBCT	Panoramic radiographs and clinical evaluation (ball vs telescopic attachments)	NR	NR	Bone volume reduction 3x higher
Lechner, Mammen 1996	Retrospective	13 (2 males, 11 females)	65 (56-78)	> 36	NR	Bar	NR	3-6 (4)	Clinical, Cephalometric	CBCT-based 3D model superimposition (3-matics software)	Reduced retention	Loss of posterior occlusion, perceived looseness	Vertical bone loss of Mx evident
Narhi et al, 2000	Prospective	52 (12 males, 40 females)	61.9	72	2 or Transmandibular implant	Bar	Lingual contact occlusion with anterior open bite	6	Clinical examination, Model	Ridge width measured on diagnostic casts using Boley gauge	Adequate retention and stability in ISO Lower retention and stability in implant mucosa supported overdenture	NR	Decrease in ridge width not associated with type of mandibular restoration

NR – Not reported, CBCT - Cone Beam Computed Tomography, Mx – Maxillary

Table 5. Overview of studies comparing mandibular Complete Dentures (CD) with Implant-supported Overdentures (ISO).

Authors, Year	Study Design	No. of Patients	Implant (number, location)	Method	Maxillary Bone Loss	Mandibular ISO			Mandibular conventional dentures
							Mainly mucosa supported implant overdentures (magnet attachment)	Combined mucosa implant-supported overdenture (bar attachment)	
Mohamed A. et al, 2007	Prospective	15	2, Canine	Clinical, Panoramic	Thickness of soft tissue on Mx ridge	1-Year Results	No Significant Difference	No Significant Difference	No Significant Difference
						2-Year Results	No Significant Difference	Significant Difference (P < 0.05)	Significant Difference (P < 0.05)
					Vertical bone loss of Mx	1-Year Results	No Significant Difference	Significant Difference (Anterior & Posterior)	Significant Difference (Maxillary Anterior), Highly Significant (Maxillary Posterior)
						2-Year Results	No Significant Difference	Significant Difference (Anterior & Posterior)	Highly Significant Difference (Both Areas)
							Implant-Mucosa–Supported Overdentures (2 implants)	Implant-Supported Overdentures (Transmandibular implant)	Complete Dentures
Narhi et al, 2000	Prospective	52 (12 males, 40)	2 or Transmandibular implant	Clinical examination, Model	Magnitude of Change in Ridge Width	Incisor	1.0 mm	1.1 mm	1.3 mm
						Canine	0.9 mm	0.9 mm	1.0 mm
						Molar	1.6 mm	1.6 mm	1.9 mm
Alsrouji et al, 2018	Prospective	18 (8 male 10 females)	2, Canine	CBCT	Changes in Mx bone volume	Bone Volume Reduction	-7.25% (3.16)		-2.6%(1.70)

of ISO treatment justify the need to synthesise existing data. This review provides a foundational appraisal of current literature, identifies key biomechanical and prosthetic factors associated with CS-like features, and highlights critical areas for future investigation.

Among the included studies, key findings include notable loss of stability and retention in maxillary dentures, along with loss of posterior occlusion and maxillary bone loss among patients receiving this treatment. Of the six studies reviewed, these characteristics of combination syndrome were observed in patients rehabilitated with implant-supported overdentures; however, most studies indicated that these effects were either not statistically different or the opposite.

Among the included studies, findings varied regarding the relationship between implant-supported mandibular overdentures (ISO) and features of Combination Syndrome (CS). Alsrouji *et al*. and Abd *et al*. reported increased anterior maxillary bone resorption and reduced denture stability in patients with ISO, consistent with clinical characteristics of CS. In contrast, Narhi *et al*. and Elsyad *et al*. found no statistically significant differences in maxillary bone loss or prosthetic complications between ISO and conventional complete dentures. These conflicting results likely reflect methodological differences, including variations in implant position, attachment type, follow-up duration, occlusal scheme, and the tools used to assess bone loss. The lack of standardisation across studies limits comparability and highlights the need for more uniform clinical and radiographic protocols in future investigations.

These inconsistencies in the literature underscore the importance of standardised research protocols and more robust evidence. Future studies should adopt prospective cohort or randomised clinical trial designs with larger, more diverse patient populations and long-term follow-up—ideally exceeding five years. The use of advanced imaging technologies such as CBCT would allow for accurate, volumetric assessment of maxillary bone changes. Studies should also aim to control and document variables such as implant number and position, attachment type, and occlusal scheme.

A reduction in retention of maxillary complete dentures was observed in patients with mandibular implant-supported overdenture, primarily due to excessive anterior contact. This excessive contact causes the denture to tilt upward and forward, resulting in a loss of the posterior seal and contributing to a sensation of looseness in the maxillary denture. In this context, mandibular implant support plays an essential role in affecting the retention and stability of the maxillary complete denture as the stability and retention of the mandibular prosthesis and maxillary prosthesis are correlated. Combined mucosa-supported overdentures, such as those with telescopic attachments, provide higher retention and stability for the mandibular overdenture compared to primarily mucosa-supported overdentures with ball attachments, thereby allowing for greater masticatory forces. This increase in force exacerbates the perception of looseness in the maxillary denture. Additionally, a study by Naert *et al*. (2004) suggests that a more stable mandibular overdenture can adversely affect the retention and stability of maxillary complete dentures.

Implant-supported mandibular overdentures alter biomechanical loading compared to conventional dentures by reducing denture movement and increasing occlusal force efficiency. However, this increased stability can lead to greater force transmission to the opposing maxillary ridge, particularly in the anterior region, potentially accelerating bone resorption. Studies such as Alsrouji *et al*. and Abd *et al*. support this, showing increased resorption with ISO compared to CD. Additionally, ISO designs using ball attachments may contribute to localised pressure and mucosal irritation, promoting flabby ridge formation. In contrast, conventional complete dentures distribute forces more evenly across the maxillary arch due to their broader tissue contact and reduced retention. These biomechanical differences highlight the need to consider prosthesis design, occlusal balance, and mucosal adaptation when evaluating the risk of Combination Syndrome.

Posterior occlusal support is one of the main contributors to the stability and retention of complete dentures, as the occlusion seats the denture into its correct position on each closure. Loss of posterior occlusion emerged as a frequent finding during clinical evaluations, significantly contributing to the perceived looseness of the maxillary denture. However, this loss was not directly linked to bone loss in the anterior region. Instead, discrepancies in posterior occlusion might arise from the wear of artificial acrylic teeth, patients' preferences for chewing on one side or the increased proprioception around the implants causing the patient to shift the lower jaw forward. This functional imbalance can lead to an increased load on specific areas of the dental arch, further complicating the clinical picture.

The variation in maxillary bone resorption observed across different attachment systems may be largely attributed to the surface area and distribution of occlusal forces transmitted to the premaxilla. Bar and telescopic attachments generally offer higher retention and stability, which can allow for greater masticatory efficiency. However, this increased stability may result in more concentrated occlusal forces being transmitted through a smaller surface area, particularly in the anterior region, leading to greater stress on the premaxillary bone. In contrast, ball and magnet attachments often provide a more flexible, mucosa-supported design that may better distribute functional forces across a broader area, thereby reducing the direct mechanical loading on the anterior maxilla. This biomechanical difference could explain the relatively lower levels of bone resorption seen with single-attachment systems, though individual patient factors and prosthetic design variations also play a role.

Even though the analysis of Narhi *et al* revealed that changes in the width of the residual alveolar ridge (particularly in the incisor, canine, and molar areas) are more pronounced in complete dentures compared to implant-mucosa-–supported

overdenture (overdenture on 2 implants) and implant-supported overdentures (overdenture on 5 implants), the six-year follow-up stated it to be statistically insignificant across the different treatment groups.

In contrast, other studies demonstrated higher bone resorption in the anterior maxilla when it is opposed by ISO than by CD[14,19]. This is supported by Alsrouji *et al* study which was a 3-dimensional investigation of loss of maxillary bone volume. In this study, the maxillary bone volume reduction is three times higher in ISO vs CD. This study identified the predominant areas affected as the buccal and occlusal ridges of the anterior maxilla.

The contradictory reports on maxillary bone resorption may be attributed to several methodological and clinical differences across studies. Factors such as the number and angulation of implants, the type of attachment system (e.g., ball vs telescopic), and variations in occlusal load distribution can influence bone remodelling in the maxillary arch. For instance, studies showing increased resorption often used bar or ball attachments, with bar attachments in particular transmitting occlusal forces more rigidly to the anterior maxilla. This effect may be exacerbated when prostheses lack posterior occlusal support or mucosal cushioning, leading to greater stress concentration and bone loss in the premaxilla. In contrast, studies reporting reduced or comparable resorption with ISO frequently included prostheses with more evenly distributed occlusion or mucosal support. Differences in assessment techniques such as clinical judgement versus CBCT analysis may also affect the sensitivity of bone loss detection, contributing to variation in outcomes. Additionally, short follow-up durations in some studies may not fully capture progressive bone changes, leading to underestimation of long-term resorption.

Kelly (1972) and Saunders (1979) identified characteristics that describe combination syndrome in patients with maxillary complete denture opposing natural mandibular anterior teeth. These characteristics includes bone loss in the maxillary anterior ridge, loss of vertical dimension of occlusion, occlusal plane discrepancies and poor adaptation of the maxillary complete denture. The presence of these characteristics in edentulous patients rehabilitated with mandibular implant supported overdenture opposing complete maxillary denture aligns with the features observed in combination syndrome. However, some studies indicated that these features did not promote conditions similar to CS. Due to the limitations of these studies such as measurement inaccuracies, limited subjects and ethical concerns, they were not able to prove that characteristics of combination syndrome are seen in patients rehabilitated with ISO. Thus, further investigation is required to determine the correlation of ISO rehabilitation with CS.

Based on the insights gained from the reviewed studies, several precautions can be beneficial for dentists and prosthodontists when considering implant-supported mandibular dentures. Due to the inherent weakness of the maxilla, it is essential to enhance its integrity through methods such as implant rehabilitation of the maxillary arch or by retaining the roots of maxillary teeth to preserve maxillary bone as described by Langer *et al*. (1995). The choice of material is also critical; for instance, opting for porcelain teeth instead of acrylic can provide superior aesthetics and wear resistance, although it may lead to increased bone resorption[2]. Regular periodontic recall appointments as well as periodic monitoring of the occlusion are necessary, to help maintain occlusal harmony and the health of supporting tissues[1,8]. Furthermore, the ISO attachment should be evaluated to determine the most suitable option for each patient, ensuring optimal outcomes and longevity of the prosthetic solutions.

The findings across the studies were heterogeneous, partly due to various limitations inherent to each study. These limitations include challenges in identifying anatomical landmarks, difficulties in tracing panoramic radiographs, and inconsistencies in the quality and completeness of records, no monitoring of the VD through time, no indication of the amount of soft tissue support provided by the prostheses, all of which contributed to inaccurate interpretations of the results. The model analyses may lead to misleading conclusions, as these analyses do not directly measure bone resorption; instead, the observed reductions may be attenuated to changes in soft tissue [16,18]. Furthermore, inaccuracies in measurements have resulted in other studies reporting instances of bone gain rather than resorption during follow-up periods[10,20]. Additionally, these studies often involved a limited subject pool, and ethical concerns regarding radiation exposure rendered it inappropriate to subject participants to multiple radiation exposures solely for research purposes.

Key findings included anterior maxillary bone loss, loss of posterior occlusion, and reduced retention of the maxillary denture, commonly attributed to excessive anterior contact. Some studies reported greater maxillary anterior ridge resorption with implant-supported overdentures, while others found no statistically significant differences compared to conventional dentures.

CONCLUSION

Our findings indicate that, while implant-supported overdentures generally offer superior stability and retention compared to conventional complete dentures, clinical concerns remain, particularly regarding maxillary bone resorption and the perceived looseness of opposing maxillary dentures. Some studies observed considerable maxillary bone loss associated with mandibular ISO opposing maxillary complete dentures, whereas others found no statistically significant differences compared to conventional dentures.

Clinically, these findings highlight the need for patient-specific risk stratification when planning mandibular implant overdentures. Treatment strategies should include occlusal scheme modifications to reduce anterior functional overload, periodic occlusal assessments, and consideration of maxillary

implant placement or retention of natural roots to preserve maxillary bone. Although the number of included studies and participants was limited, this reflects the scarcity of focused research in this specific clinical context. Future longitudinal studies incorporating CBCT-based assessments and standardised CS diagnostic criteria are essential to strengthen the evidence base. These approaches may help mitigate the development of features associated with Combination Syndrome and optimise long-term treatment outcomes.

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CONFLICT OF INTEREST

There are no conflicts of interest to report.

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