RADIOGRAPHIC CHANGES AFTER TOOTH LOSS

Reappraisal of the original clinical series and integration of evidence published between 2021 and 2025

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Revised and updated version of the study originally published in 2009

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ABSTRACT

Background Tooth loss initiates alveolar ridge remodelling and may allow displacement of adjacent teeth and the antagonist, with potential effects on prosthetic rehabilitation.

Objective To present the findings of the original radiographic series and interpret them in relation to recent literature.

Material and method The original study included 19 patients, 13 women and 6 men, with a mean age of approximately 24 years. Radiographs were obtained before extraction and after a mean interval of 6.9 months. The narrative update examined meta-analyses and clinical studies published in 2021-2025 on ridge remodelling, tooth migration, overeruption and alveolar ridge preservation.

Results The original series found no statistically significant mean differences for the four reported measurements, but described ridge reduction and differences between molar and premolar regions. Recent evidence confirms mean horizontal reduction of approximately 2.5-3.6 mm and vertical reduction of approximately 0.9-1.7 mm, depending on tooth type and measurement method. Alveolar ridge preservation attenuates dimensional loss without eliminating it.

Conclusion The original findings are biologically plausible, but the small sample and non-standardised imaging preclude precise estimation of the effect. Rehabilitation planning should be individualised and should begin at the time of extraction.

Keywords: tooth extraction; partial edentulism; alveolar remodelling; tooth migration; overeruption; alveolar ridge preservation.

INTRODUCTION

Tooth extraction alters local anatomy and the functional equilibrium of the dental arch. Socket healing is accompanied by resorption of bundle bone and remodelling of the buccal and oral walls. The resulting reduction may complicate three-dimensional implant positioning, bridge contours and the achievement of a favourable emergence profile.

Loss of proximal and occlusal contacts may be followed by tilting or translation of adjacent teeth and overeruption of the antagonist. Progression is not uniform. Tooth type, position in the arch, periodontal status, socket anatomy, occlusion, age and time elapsed since extraction may modify the magnitude of the response.

The original study used radiographs to monitor changes in young patients after extraction. This version preserves the reported data, revises the structure and terminology, clarifies methodological limitations and integrates quantitative findings from recent literature, without retrospectively altering the original sample or its methodology.

DOI : 10.62610/RJOR.2026.3.18.12

MATERIAL AND METHOD

Original clinical series

Nineteen patients were evaluated, including 13 women and 6 men, with a mean age of approximately 24 years. The original report does not specify the selection method, inclusion and exclusion criteria, reasons for extraction, maxillary-mandibular distribution, smoking, periodontal status or systemic diseases. This information cannot be reconstructed and has not been supplemented with assumptions.

Radiographic assessment

Radiographs were obtained before extraction and after healing, at a mean interval of 6.9 months. Images were digitised and archived electronically. Changes in the edentulous space, adjacent teeth and the antagonist were monitored. Commercial positioning devices attached to conventional periapical films were used for bitewing radiographs.

Reproducibility and analysis

Two examiners independently selected landmarks and performed measurements, with agreement required within 0.5 mm. The source article mentions a significance threshold of 0.05 but does not specify the statistical test, standard deviations, confidence intervals or exact p values. The inferential analysis should be interpreted as exploratory.

Literature update

Priority was given to systematic reviews, meta-analyses and clinical studies from 2021-2025 addressing spontaneous socket healing, ridge preservation, periodontally compromised molar sockets and displacement of unopposed teeth. Data from recent publications are presented separately from the findings for the 19 patients and are not statistically pooled with them.

RESULTS OF THE ORIGINAL SERIES

No statistically significant mean differences were reported for the four radiographic measurements. This finding does not demonstrate an absence of change. Statistical power was low, and errors in angulation and landmark identification may be similar in magnitude to the changes being monitored.

Descriptively, space reduction was associated with bone loss in the premolar region, but not in the molar region. Extrusion of the antagonist was not significantly associated with the other measurements. In the absence of effect estimates and confidence intervals, these associations cannot be interpreted causally.

Table I. Dimensional distribution reported at approximately 6 months

Region	0.1-1 mm	1.1-2 mm	2.1-3 mm
Molar sites n 11	54.54%	27.27%	18.18%
Premolar sites n 8	37.50%	50.00%	12.50%

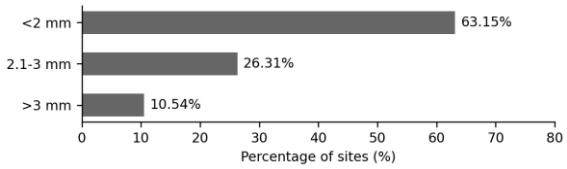


Figure 1. Overall distribution reproduced from the source article

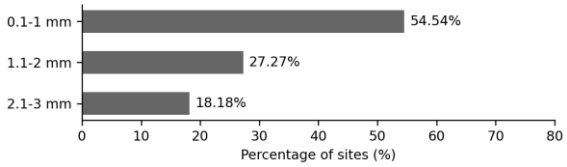


Figure 2. Reported distribution for molar sites

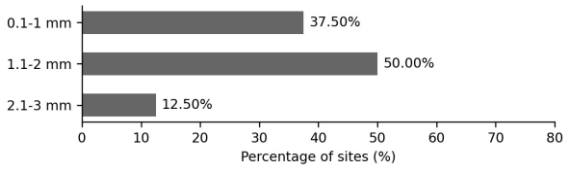


Figure 3. Reported distribution for premolar sites

The source article groups the overall change as follows: less than 2 mm in 63.15% of cases, 2.1-3 mm in 26.31%, and more than 3 mm in 10.54%. The variable termed overall bone mass loss is insufficiently defined to be mathematically reconciled with the separate molar and premolar distributions. The percentages have been reproduced descriptively and have not been recalculated.

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CURRENT EVIDENCE

Ridge remodelling after spontaneous healing

The meta-analysis published by Couso-Queiruga and colleagues included 28 articles, of which 20 could be used in quantitative analyses. For non-molar sites, mean horizontal reduction was 2.73 mm clinically and 2.54 mm radiographically. Buccal vertical reduction was 1.71 mm clinically and 1.65 mm radiographically, while oral reduction was 1.44 mm clinically and 0.87 mm radiographically. For molar sites, radiographic estimates were 3.61 mm horizontally, 1.46 mm buccally and 1.20 mm orally [1].

These values are not directly comparable with the percentages in the 2009 series because the populations, landmarks and imaging methods differ. However, they support two important observations: loss is greater horizontally than vertically, and molars and non-molar teeth should be analysed separately.

Buccal plate thickness influences the severity of remodelling. A plate thinner than 1 mm, socket wall defects, periodontal involvement, smoking, poor metabolic control and surgical trauma are factors that may increase risk or delay healing [2,3].

Tooth migration and overeruption of the antagonist

Recent evidence on displacement of adjacent teeth is less extensive than that on bone remodelling. Three-dimensional studies show that tilting, translation and rotation are possible, but their magnitude is not constant. Therefore, the statement that adjacent teeth may move is supported, whereas the claim that migration necessarily occurs after every extraction would exceed the available evidence.

Wang and colleagues analysed 59 patients and 68 molars without antagonists. Over 9.2 ± 4.3 months, mean cusp overeruption was 0.432 mm, the mean maximum value was 0.753 mm, and mean buccal tipping was 1.717°. Changes were significant relative to baseline, but the study was retrospective and cannot define a universal threshold for intervention [4].

Alveolar ridge preservation

Alveolar ridge preservation involves placing a biomaterial in the socket, with or without a sealing membrane, immediately after extraction. The aim is to reduce dimensional loss and simplify subsequent rehabilitation. Recent literature consistently shows that the intervention attenuates resorption but does not eliminate it.

The network meta-analysis by Khijmatgar and colleagues included 88 randomised trials, 2,805 patients and 3,073 sockets; 1,740 sockets underwent preservation and 1,432 were covered with membranes. Compared with spontaneous healing, the evaluated materials significantly reduced horizontal and vertical contraction. No single material was identified as superior for both volume maintenance and new bone formation [5].

For periodontally compromised molars, Fok and colleagues included six studies, 130 patients and 135 sockets: 68 treated with preservation and 67 allowed to heal spontaneously. At 4-6 months, the mean difference favouring preservation was 3.80 mm for buccal width measured 1 mm below the crest and 2.18 mm for buccal height. The certainty of evidence was low or very low, and the intervention did not eliminate the need for augmentation at implant placement [3].

Reviews from 2023-2025 confirm the dimensional benefit, particularly at high-risk sites and when implant placement is delayed. Long-term patient- and implant-centred outcomes remain less well documented than changes measured at 4-6 months [2,6,7].

Numerical synthesis of the evidence

DOI : 10.62610/RJOR.2026.3.18.12

Table II. Relevant studies published in 2021-2025

Source	Design and sample	Relevant finding	Certainty and limitation
Couso-Queiruga 2021	28 articles; 20 in meta-analyses	Horizontal reduction of 2.54 mm at non-molar and 3.61 mm at molar sites	Heterogeneity of methods and sites
Khijmatgar 2022	88 RCTs; 2,805 patients; 3,073 sockets	All material classes reduced contraction compared with spontaneous healing	No universally superior biomaterial
Wang 2022	59 patients; 68 unopposed molars	Mean overeruption of 0.432 mm in 9.2 months	Retrospective cohort
Fok 2024	6 studies; 130 patients; 135 molar sockets	Advantage of 3.80 mm in width and 2.18 mm in height	Low or very low certainty
Wei 2025	Systematic review and meta-analysis of molars	Preservation reduces ridge changes and probably the need for augmentation	Heterogeneous protocols and biomaterials

DISCUSSION

The original series addresses a real clinical problem, but the sample size and non-standardised radiographs limit the conclusions. Inter-examiner agreement within 0.5 mm is close to the magnitude of some monitored changes, and differences in angulation may generate errors of a similar order. Lack of statistical significance therefore does not exclude a biologically or clinically relevant effect.

Recent data reinforce the observation that remodelling differs between regions. Horizontal loss is greater at molar than at non-molar sites, and the local phenotype modifies prognosis. Conversely, the overall percentages in the original series cannot be generalised because the measured variable is incompletely defined and the sample has not been shown to be representative.

The number of patients in the original study cannot be optimised retrospectively. A valid increase in sample size requires a new prospective protocol. For a future study, sample size should be calculated from a single primary outcome, such as horizontal ridge change at 6 months, the clinically relevant difference, anticipated standard deviation, statistical power and attrition rate. Using samples from meta-analyses as contextual evidence strengthens the discussion but does not turn the 19-patient series into a larger study.

Clinically, the timing of extraction should be linked to the rehabilitation plan. It is useful to document socket wall integrity, buccal plate thickness, periodontal status and occlusion, and to monitor proximal contacts, tooth inclination and antagonist position. The indication for alveolar ridge preservation should be individualised; the procedure is not mandatory in all cases and does not guarantee that subsequent augmentation will be avoided.

Recommendations for a prospective study

Define a prespecified primary outcome and calculate sample size before recruitment.

Establish inclusion and exclusion criteria and record the reason for extraction.

Stratify sites into molar and non-molar groups and according to the maxilla, mandible and socket wall integrity.

Standardise radiographic geometry and use calibrated intraoral scanning for repeated three-dimensional measurements.

Report absolute changes, standard deviations, 95% confidence intervals, exact p values and examiner reproducibility.

Record smoking, diabetes, periodontal

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status, occlusal contacts and prosthetic treatment performed during follow-up.

Follow up at 3, 6 and 12 months, with clinical, radiographic and patient-reported outcomes.

CONCLUSIONS

The radiographic series of 19 patients described alveolar ridge reduction and region-dependent changes during approximately the first 7 months after extraction, without demonstrating statistically significant mean tooth displacement. The small sample, incomplete reporting and non-standardised imaging prevent precise estimation of the effect.

The literature from 2021-2025 confirms that ridge reduction occurs frequently and is more pronounced horizontally. At molar sites, the mean horizontal reduction reported in a meta-analysis is approximately 3.6 mm. Adjacent teeth may move, and unopposed molars may overerupt during the first year, but the magnitude varies and does not justify deterministic statements.

Alveolar ridge preservation reduces dimensional loss and may reduce the need for augmentation, but it does not stop remodelling or guarantee sufficient volume for an implant. No single biomaterial is superior for all objectives. Treatment decisions should be based on site anatomy, patient risk, rehabilitation timing and the intended prosthetic outcome.

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