CORONAL INTEGRITY OF MAXILLARY CANINES AND ITS ROLE IN CANINE GUIDANCE RECONSTRUCTION: CLINICAL, RESTORATIVE AND BIOMECHANICAL CONSIDERATIONS

Kamel Earar [1,2], Rahela Chiș [3,*], Razvan Leata [1,2,*], Dorin Ioan Cocoș[1,2], Antoanela Magdalena Covaci [1,2]

1. "Dunărea de Jos" University of Galati, Faculty of Medicine and Pharmacy, Medical and Pharmaceutical Research Center, 800008 Galati, Romania.
2. Dental-Medicine Department, Faculty of Medicine and Pharmacy, "Dunărea de Jos" University of Galati, 800201 Galati, Romania.
3. Department of Medical Disciplines, Faculty of Dental Medicine, University of Târgu Mureș 540099 Romania.

* Corresponding authors: Rahela Chiș: cocosrahela@yahoo.com
Razvan Leata: razvanleata@yahoo.com
† All authors contributed equally to this work.

Abstract

Background: Canine guidance plays an important role in lateral mandibular function, but its stability can be affected by loss of canine maxillary coronal integrity, and our pilot clinical study evaluated the relationship between the maxillary structural condition of dogs, lateral guidance patterns, and restorative–biomechanical findings. **Methods:** Thirty adult patients were divided into three equal groups according to canine coronal integrity: intact/minimally altered canines, moderately compromised canines, and severely compromised or prosthetically reconstructed canines. A canine coronal integrity score was used to quantify structural and functional compromise. Clinical assessment included canine cusp morphology, palatal functional contour, restorative status, lateral excursive contacts, posterior interferences, and biomechanical risk indicators. **Results:** The canine coronal integrity score increased progressively from Group 1 to Group 3. Pure canine guidance was most frequent in patients with preserved canine morphology, whereas mixed guidance, group function, unstable lateral contacts, posterior interferences, restoration wear, and need for occlusal adjustment or guidance reconstruction increased in compromised groups. High biomechanical risk was most frequent in severely compromised/reconstructed canines. **Conclusions:** Our article suggests that maxillary canine coronal integrity is clinically associated with the quality of canine guidance and with restorative–biomechanical risk during lateral mandibular excursions.

Keywords: canine guidance, maxillary canine, coronal integrity, tooth wear, occlusion, restorative dentistry

1. Introduction

Canine guidance remains a clinically relevant determinant of lateral mandibular function because maxillary canine morphology influences anterior disclusion and the transmission of oblique occlusal loads, and experimental evidence indicates that reconstruction of canine guidance with ceramic or composite resin modifies stress distribution and wear behavior, supporting assessment of the canine guidance surface as a functional structure rather than only as an anterior crown unit [1]. This issue is important when guidance is maintained on crowned teeth, where restorative contour, material stiffness, and long-term stability may alter the protective role attributed to natural canines [1,2]. Conservative adhesive approaches, including canine rise reconstruction, have therefore been proposed for worn anterior teeth to restore function while preserving dental tissues [3]. Digital resin composite injection workflows further suggest that minimally invasive reconstruction of canine guidance is feasible, although long-term stability requires additional evidence [4-6].

Dynamic occlusion is closely linked to tooth wear. Clinical data suggest that wear patterns may correlate with functional occlusal conditions, indicating that anterior

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guidance and posterior contacts during excursions should be interpreted together [5], and however, canine-protected occlusion remains debated, and contemporary guidance supports individualized diagnosis rather than routine application of a single occlusal scheme [6]. Comparisons with alternative arrangements, including group function, show that the relevance of canine guidance depends on dentition type, restorative context, and biomechanical loading [3-7]. Finite element analyses in prosthetic and implant-supported restorations demonstrate that occlusal concepts can influence stress concentration within restorative components and supporting tissues [8,9]. At the same time, the relationship between occlusion and temporomandibular disorders is complex, so occlusal findings should not be interpreted as isolated causal factors [10].

Tooth wear and bruxism represent additional modifiers of anterior guidance, because parafunctional loading may accelerate cusp flattening, restoration wear, and contour degradation [11,12], and broader reviews identify tooth wear as a multifactorial process involving mechanical, behavioral, and restorative determinants [13-16]. Direct composite restorations are widely used for localized anterior tooth wear, but their performance depends on case selection and occlusal control [4,16-19]. On this basis, our article evaluates maxillary canine coronal integrity in relation to canine guidance patterns, lateral excursive contacts, and restorative-biomechanical implications.

2. Materials and Methods

2.1. Our study design and population

Our cross-sectional pilot clinical study evaluated the relationship between canine maxillary coronal integrity and the presence, quality, and stability of canine guidance during lateral mandibular excursions, and our study focused on adult patients with both permanent maxillary canines present, aiming to identify clinical associations between canine structural preservation, restorative status, and lateral occlusal behavior.

Thirty adult patients were divided into three equal groups according to maxillary canine coronal integrity and functional morphology, - group 1 included intact or minimally altered canines with preserved cusp morphology, intact palatal contour, and no restorations affecting the guidance surface, -group 2 included moderate coronal compromise, with cusp flattening, localized enamel/dentin wear, limited palatal contour loss, or direct restorations involving the guidance area, - group 3 included severely compromised or prosthetically reconstructed canines, with severe cusp loss, marked palatal alteration, extensive restorations, veneers, crowns, major reconstructions, or endodontically treated canines with major coronal restoration.

2.2. Inclusion and exclusion criteria

Patients were eligible for inclusion if they were adults, with an observed study age range of 27–68 years, had both permanent maxillary canines present, and presented sufficient anterior and posterior dentition to allow reliable clinical assessment of lateral excursive contacts, and the morphology of the maxillary canine cusp, the palatal functional contour, and the canine guidance surface had to be clinically assessable, and patients were also required to have a stable intercuspal position and the ability to perform reproducible right and left lateral mandibular excursions during occlusal examination.

The exclusion criteria were absence of one or both permanent maxillary canines, extensive anterior or posterior edentulism

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preventing reliable evaluation of lateral guidance, complete removable prosthetic rehabilitation, active orthodontic treatment, recent full-mouth rehabilitation involving complete occlusal redesign, severe periodontal mobility affecting the maxillary canines, acute dental pain or temporomandibular symptoms limiting mandibular movements, history of severe craniofacial trauma, neuromuscular disorders affecting mandibular function, and incomplete clinical records.

2.3. Clinical assessment of maxillary canine coronal integrity

Maxillary canine coronal integrity was assessed clinically by evaluating the anatomical and functional elements involved in lateral guidance, including cusp morphology, palatal guidance surface, functional contour continuity, enamel or dentin loss, and restorations affecting the guidance area.

A canine coronal integrity score (CCIS) was used to quantify structural and functional compromise at the patient level, considering both maxillary canines and emphasizing the tooth with greater functional alteration, and lower CCIS values indicated preserved cusp morphology and intact palatal contour, whereas higher values reflected cusp loss, altered functional morphology, extensive restorations, or prosthetic reconstruction. Recorded features included cusp preservation or flattening, severe cusp loss, palatal contour alteration, enamel/dentin wear, direct or indirect restorations, veneers, crowns, extensive reconstructions, and endodontically treated canines with major coronal restoration, and non-carious cervical lesions were recorded separately, unless they affected the functional coronal contour.

2.4. Assessment of canine guidance and lateral excursive contacts

Occlusal assessment was performed during right and left lateral mandibular excursions, and the dominant lateral guidance pattern was classified as pure canine guidance, mixed guidance, or group function. Pure canine guidance was defined as lateral disclusion guided predominantly by the maxillary and mandibular canine contact, with posterior disclusion during excursion, and tixed guidance was defined as canine contact associated with additional anterior or posterior contacts during lateral movement, and group function was defined as the simultaneous contact of several teeth on the working side during lateral excursion, and the presence of absent or unstable canine guidance, posterior working-side interferences, non-working-side interferences, bilateral stable canine guidance, unilateral canine guidance, and the need for occlusal adjustment or canine guidance reconstruction was also recorded.

2.5. Restorative, biomechanical, and outcome assessment

Restorative and biomechanical findings were assessed in relation to maxillary canine status and the observed lateral guidance pattern, and recorded variables included posterior occlusal wear facets, premature or unstable lateral contacts, non-working-side contacts, restoration wear or contour degradation, fractured or compromised restorations, localized dentin hypersensitivity, and the need for occlusal adjustment or canine guidance reconstruction. A high biomechanical risk profile was defined as the coexistence of at least two unfavorable findings, such as unstable lateral contacts, posterior interferences, restoration wear, premature contacts, or need for guidance

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reconstruction. The primary outcome was the relationship between CCIS and the dominant lateral guidance pattern, while secondary outcomes included interferences, unstable contacts, treatment needs, and restorative–biomechanical complications among groups.

2.6. Statistical analysis

Data were analyzed using IBM SPSS Statistics for Windows, using version 29.0 (IBM Corp., Armonk, NY, USA); Due to the exploratory design and limited sample size, the analysis was mainly descriptive, and continuous variables were reported as mean ± standard deviation and median with interquartile range, where appropriate. Categorical variables were expressed as absolute frequencies and percentages, and the distribution of canine coronal compromise, lateral guidance patterns, and restorative or biomechanical findings was descriptively compared between the three study groups, and given the pilot nature of our study and the small number of patients per group, inferential statistical conclusions were considered exploratory.

3. Results

3.1. Study group characteristics

Our study included 30 adult patients equally divided into three groups according to canine maxillary coronal integrity, and the overall average age was 44.7 ± 10.9 years, with a relatively balanced gender distribution: 16 females and 14 males, and parafunctional habits and bruxism-related signs were more common in Groups 2 and 3, while both maxillary dogs were present in all patients according to the inclusion criteria (Table 1).

Table 1. Study group characteristics

Parameter	Group 1: Intact/minimally altered canines (n = 10)	Group 2: Moderate coronal compromise (n = 10)	Group 3: Severe compromise/ reconstructed canines (n = 10)	Total (N = 30)
Age, years, mean ± SD	39.8 ± 8.7	44.6 ± 10.1	49.7 ± 11.4	44.7 ± 10.9
Age range, years	27–54	31–61	35–68	27–68
Female, n (%)	6 (60.0)	5 (50.0)	5 (50.0)	16 (53.3)
Male, n (%)	4 (40.0)	5 (50.0)	5 (50.0)	14 (46.7)
Presence of both maxillary canines, n (%)	10 (100.0)	10 (100.0)	10 (100.0)	30 (100.0)
Reported or clinically suspected bruxism, n (%)	2 (20.0)	5 (50.0)	6 (60.0)	13 (43.3)
Non-carious cervical lesions, n (%)	1 (10.0)	4 (40.0)	5 (50.0)	10 (33.3)
Previous restorative treatment on maxillary canines, n (%)	0 (0.0)	5 (50.0)	10 (100.0)	15 (50.0)
Endodontically treated maxillary canine, n (%)	0 (0.0)	1 (10.0)	3 (30.0)	4 (13.3)
Angle Class I, n (%)	7 (70.0)	6 (60.0)	5 (50.0)	18 (60.0)
Angle Class II, n (%)	2 (20.0)	3 (30.0)	3 (30.0)	8 (26.7)

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Angle Class III, n (%)	1 (10.0)	1 (10.0)	2 (20.0)	4 (13.3)

3.2. Coronal integrity status of maxillary canines

Maxillary canine coronal integrity decreased progressively across the three groups. Group 1 showed preserved cusp morphology, intact palatal functional contour, and no extensive canine restorations. Group 2 presented moderate alterations, mainly cusp flattening, localized enamel/dentin wear, partial loss of palatal contour, and direct restorations involving the guidance surface. Group 3 showed the greatest compromise, with severe cusp loss, altered palatal morphology, indirect prosthetic reconstructions, and more endodontically treated canines. The mean CCIS increased progressively from Group 1 to Group 3, confirming the predefined clinical separation between groups (Table 2).

Table 2. Coronal integrity status of maxillary canines

Parameter	Group 1: Intact/minimally altered canines (n = 10)	Group 2: Moderate coronal compromise (n = 10)	Group 3: Severe compromise /reconstructed canines (n = 10)	Total (N = 30)
CCIS, mean +/- SD	0.7 +/- 0.5	2.9 +/- 0.7	6.1 +/- 0.9	3.2 +/- 2.4
CCIS median (IQR)	1.0 (0-1)	3.0 (2-3)	6.0 (5-7)	3.0 (1-6)
Preserved canine cusp morphology, n (%)	9 (90.0)	2 (20.0)	0 (0.0)	11 (36.7)
Mild cusp flattening, n (%)	3 (30.0)	4 (40.0)	1 (10.0)	8 (26.7)
Moderate cusp flattening, n (%)	0 (0.0)	7 (70.0)	2 (20.0)	9 (30.0)
Severe cusp loss, n (%)	0 (0.0)	0 (0.0)	8 (80.0)	8 (26.7)
Preserved palatal functional contour, n (%)	10 (100.0)	3 (30.0)	1 (10.0)	14 (46.7)
Altered palatal functional contour, n (%)	0 (0.0)	7 (70.0)	9 (90.0)	16 (53.3)
Non-carious cervical lesions, n (%)	1 (10.0)	4 (40.0)	5 (50.0)	10 (33.3)
Direct restorations affecting canine contour, n (%)	0 (0.0)	5 (50.0)	4 (40.0)	9 (30.0)
Indirect restoration/crown/veneer, n (%)	0 (0.0)	0 (0.0)	6 (60.0)	6 (20.0)
Endodontically treated maxillary canine, n (%)	0 (0.0)	1 (10.0)	3 (30.0)	4 (13.3)

3.3. Canine guidance patterns and lateral excursive contacts

Lateral guidance patterns showed a progressive change across the three groups. Stable pure canine guidance was most

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frequent in patients with intact or minimally altered maxillary canines, whereas moderate coronal compromise was associated with fewer pure canine guidance patterns and more mixed guidance or group function. In severely compromised or prosthetically reconstructed canines, canine guidance was often replaced by group function or unstable lateral contacts, and posterior working-side and non-working-side interferences were also more common in compromised groups, suggesting a less favorable distribution of lateral occlusal forces (Table 3).

Table 3. Canine guidance patterns and lateral excursive contacts

Parameter	Group 1: Intact/minimally altered canines (n = 10)	Group 2: Moderate coronal compromise (n = 10)	Group 3: Severe compromise/reconstructed canines (n = 10)	Total (N = 30)
Pure canine guidance, n (%)	8 (80.0)	4 (40.0)	2 (20.0)	14 (46.7)
Mixed guidance, n (%)	2 (20.0)	3 (30.0)	3 (30.0)	8 (26.7)
Group function, n (%)	0 (0.0)	3 (30.0)	5 (50.0)	8 (26.7)
Absent or unstable canine guidance, n (%)	0 (0.0)	1 (10.0)	4 (40.0)	5 (16.7)
Posterior working-side interferences, n (%)	1 (10.0)	4 (40.0)	6 (60.0)	11 (36.7)
Non-working-side interferences, n (%)	0 (0.0)	2 (20.0)	5 (50.0)	7 (23.3)
Bilateral stable canine guidance, n (%)	7 (70.0)	3 (30.0)	1 (10.0)	11 (36.7)
Unilateral canine guidance only, n (%)	2 (20.0)	4 (40.0)	3 (30.0)	9 (30.0)
Need for occlusal adjustment/reconstruction, n (%)	0 (0.0)	4 (40.0)	8 (80.0)	12 (40.0)

Findings are reported at the patient level. Guidance patterns describe the dominant lateral excursive pattern observed clinically; however, interferences and unilateral/bilateral guidance characteristics may overlap within the same patient (Figure 1).

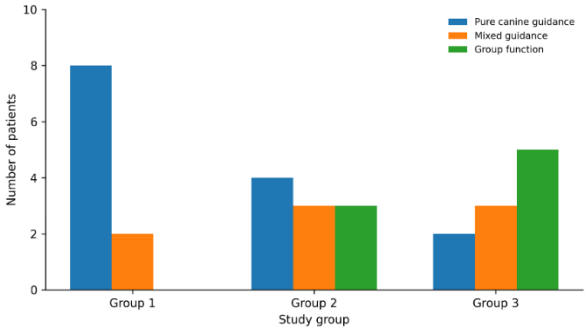

Figure 1. Distribution of canine guidance patterns among the study groups.

The frequency of pure canine guidance decreased from Group 1 to Group 3, whereas group function became more frequent in patients with moderate or severe canine coronal compromise.

3.4. Restorative and Biomechanical Implications

Clinical and restorative findings showed a progressive increase in biomechanical risk indicators from Group 1 to Group 3. Patients with preserved maxillary canine morphology showed minimal signs of unfavorable lateral

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loading and rarely required occlusal correction. In Group 2, moderate coronal compromise was associated with a higher frequency of posterior occlusal wear, unstable excursive contacts, and direct restoration wear or contour modification. Group 3 showed the highest prevalence of restorative and biomechanical complications, including posterior wear facets, premature contacts during lateral excursions, restoration-related contour instability, and a greater need for canine guidance reconstruction. These findings suggest that compromised canine coronal morphology may reduce the protective role of canine guidance and contribute to less favorable distribution of lateral occlusal forces (Table 4).

Table 4. Restorative and biomechanical implications

Parameter	*Group 1: Intact/minimally altered canines (n = 10)*	*Group 2: Moderate coronal compromise (n = 10)*	*Group 3: Severe compromise/ reconstructed canines (n = 10)*	*Total (N = 30)*
Posterior occlusal wear facets, n (%)	1 (10.0)	4 (40.0)	7 (70.0)	12 (40.0)
Premature contacts during lateral excursions, n (%)	1 (10.0)	3 (30.0)	6 (60.0)	10 (33.3)
Unstable lateral excursive contacts, n (%)	0 (0.0)	3 (30.0)	7 (70.0)	10 (33.3)
Non-working-side contact during excursion, n (%)	0 (0.0)	2 (20.0)	5 (50.0)	7 (23.3)
Restoration wear or contour degradation, n (%)	0 (0.0)	4 (40.0)	6 (60.0)	10 (33.3)
Fractured or clinically compromised restoration, n (%)	0 (0.0)	1 (10.0)	4 (40.0)	5 (16.7)
Localized dentin hypersensitivity, n (%)	1 (10.0)	3 (30.0)	5 (50.0)	9 (30.0)
Need for canine guidance reconstruction, n (%)	0 (0.0)	4 (40.0)	8 (80.0)	12 (40.0)
Need for occlusal adjustment, n (%)	0 (0.0)	4 (40.0)	8 (80.0)	12 (40.0)
High biomechanical risk profile, n (%)	0 (0.0)	2 (20.0)	7 (70.0)	9 (30.0)

The findings were reported at the patient level and indicate the presence of each feature in at least one dog in the jaw or during clinical occlusal examination, and the individual, restorative and biomechanical ones may coincide within the same patient.

4. Discussion

In this article of ours, we evaluated whether the maxillary coronal integrity of the canine is associated with the stability of canine guidance and restorative-biomechanical findings during lateral mandibular excursions, and the main observation of our article was a progressive functional change: the preserved canine morphology was mainly associated with pure and bilateral canine guidance, while moderate and severe compromise was accompanied by mixed guidance, group function, posterior interference, unstable excursion contacts, and a greater need for occlusal correction or guided reconstruction, and this pattern is consistent with biomechanical evidence showing that canine guide reconstruction with ceramic or composite resin may alter voltage distribution and wear behavior [1], as well

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as with the concern that crowned or extensively restored dogs may not be able to replicate the functional performance of intact natural dogs [2].

These findings support a conservative restorative interpretation. In moderately compromised canines, loss of cusp height and alteration of the palatal contour did not necessarily eliminate canine guidance, but reduced its stability and increased overlapping posterior contacts. This agrees with reports describing adhesive canine rise techniques and composite-based digital workflows as minimally invasive options for re-establishing lateral guidance in selected worn dentitions [3,4]. Nevertheless, our results suggest that reconstruction should not be planned as a purely morphological procedure; it should also consider dynamic occlusion, parafunctional loading, and existing restorations. Since contemporary evidence does not support a single ideal occlusal scheme for every patient, canine-protected occlusion should be interpreted within the broader clinical context [6,7].

The association between canine compromise, posterior wear facets, and unstable lateral contacts is clinically plausible, because tooth wear is multifactorial and may be amplified by bruxism, unfavorable excursive contacts, and restorative contour degradation [11–13]. The higher prevalence of biomechanical risk indicators in the severely compromised/reconstructed group corresponds with evidence that direct and indirect restorations for tooth wear require careful occlusal control to improve longevity [15–19]. For ceramic veneers or endodontically treated anterior teeth, substrate quality and restorative design may further influence survival and stress distribution [20,21].

Our article has limitations, and the pilot cross-sectional design, small sample size, and clinical nature of the occlusal assessment prevent causal conclusions. The CCIS was used as a pragmatic patient-level score and should be validated in larger cohorts with examiner calibration, digital occlusal analysis, and longitudinal follow-up. Even so, the present results indicate that canine coronal integrity may represent a useful marker for identifying patients at risk of unstable lateral guidance and increased restorative–biomechanical demand.

5. Conclusions

Our article shows that reduced maxillary canine coronal integrity is associated with deterioration of canine guidance, with a shift from stable canine-protected patterns toward mixed guidance, group function, posterior interferences, unstable contacts, and increased restorative–biomechanical risk, and therefore, canine cusp morphology, palatal functional contour, restorative status, and lateral occlusal behavior should be carefully assessed during diagnosis and treatment planning, particularly in patients with tooth wear, extensive restorations, prosthetic reconstructions, or suspected parafunction.

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