

Research Article

Diagnostic Approaches of Palatogingival Groove: A Systematic Review

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Abstract

Palatogingival Grooves (PGG) constitute developmental anatomical irregularities primarily situated along the palatal aspects of the roots of maxillary incisors. Literature is sparse on diagnostic approaches of PGG. Our study aimed to alleviate clinicians the process of recognizing anomaly. Systematic electronic searches of scientific literature without publication date or language restriction were undertaken in 2023.11.03 research was conducted in PubMed, Willey Online Library, Science Direct and Medline Ovid. Using specific keywords 54 articles with 67 cases were included in our study according to inclusion and exclusion criteria. Pre-made Cochrane data extraction templates were used for frequency evaluation, nonparametric Spearman's, Kendall rank correlation coefficients, Mann-Whitney U Test and Odds ratio was assessed by statistic to evaluate significant correlations. Most quantitatively expressed symptoms of PGG included increased tooth mobility, appearance of purulent discharge, sinus tract and periodontal pocket with an average mean of $9,14 \pm 2,30$ mm along with painful vertical percussion. However, statistical assessment showed inverse correlation between increased mobility and painful percussion. Furthermore, quantitatively, deeper periodontal pockets were accompanied by more prominent gingival alterations, however only one opposing significant correlation was noted between the depth of periodontal pocket and existence of additional root. Frequency evaluation revealed that IPR was the main diagnostic tool used in majority of cases. Deeper periodontal pocket was assessed by conjunction of two or three tools. CBCT was used most with deeper periodontal pocket averaging $9,75 \pm 1,02$ mm. In conclusion, quantitative data suggest that periodontal pockets averaging $9,14 \pm 2,30$ mm, I or II-degree mobility,

painful percussion and purulent discharge are the main PGG characteristics, with sparse significant correlations between them. IPR was noted as the main roentgenological modality as should be used firstly when suspecting PGG, yet both quantitative and statistical data suggest that CBCT is ought to be used to alleviate the assessment.

Keywords: Palatogingival Groove; Palatal Groove; Diagnosis; Recognition

Introduction

Palatogingival Grooves (PGG) constitute developmental anatomical irregularities primarily situated along the palatal aspects of the roots of maxillary incisors [1,2]. Commonly PGG origin is within the lingual fossa of the maxillary lateral incisor, proceeding apically across the cingulum and the Cementoenamel Junction (CEJ), culminating at diverse depths and lengths along the roots [3].

PGGs exhibit an estimated occurrence rate of approximately 1.01% to 8,5% as majority of studies non arguably noted greater manifestation predilection for lateral incisors [1-7]. Research conducted on morphology of this anomaly concluded PGG to be unilateral in 61.5% and bilateral in 38.5% of cases, wherein preponderance was classified as type I (69.2%), abided by type II (15.4%) and type III (15.4%) [8].

Estimating from a clinical perspective, PGG consequently leads to the development of a combination of endodontic and periodontic disease. Progression and specific clinical presentation can predetermine early misdiagnosis of individuals presenting with a pathologic condition associated with PGG. In most cases the onset of pathology might not be apparent until later stages, majority of times presenting itself with the appearance of alterations of alveolar mucosa, thereby inevitably creating conundrum in diagnosis of it [9-12].

Inescapably Intraoral Periapical Radiographs (IPR) are useful as complementary diagnostic modality, but their bidimensionality perplexes diagnosing these embryonic root grooves. Therefore, supplementary comprehensive diagnostic tools, such as Cone Beam Computed Tomography (CBCT) scan, could be required to obtain precise reconstructed high-resolution three-dimensional images of teeth and surrounding tissues and thus furnish more information about the internal canal anatomy and external root morphology including the extent of radicular groove [8,13]. However, videlect early diagnosis of grooves is crucial as it can reduce the extent of the lesion and complexity of needed treatment [14]. Therefore, this systematic review aimed to answer the following question: What expedience diagnostic approaches should be applied in the presence of clinical features suggesting the presence of PGG?

Materials and Methods

Eligibility Criteria

Inclusion Criteria: The Population (P), Exposure (E) and Outcome (O) -PEO acronym was used to develop the main question of this systematic review, where P was: individuals with symptoms associated with existence of PGG in maxillary incisors; E: roentgenological diagnostic intervention; O: diagnosed PGG. Due to the lack of pulished information on the subject case reports and case series incorporated in this systematic review would require to have thorough description of clinical and roentgenological modalities used to diagnose the anomaly of PGG in maxillary incisors for patients over 18 years.

Exclusion Criteria: *In-vivo* studies with animals, *ex-vivo* studies, *in-vitro* studies, commentaries, conference abstracts, letters and short surveys were excluded. Studies where PGG was NOT located in maxillary lateral or central incisor, studies bereft thorough description of clinical and roentgenological modalities used to diagnose the anomaly of PGG in maxillary incisors were also eliminated.

Information Sources and Search Strategy

Systematic electronic searches of scientific literature without publication date or language restriction were undertaken in 2023.11.03 Research was conducted in 4 electronic databases: PubMed, Willey Online Library, Science direct and Medline Ovid. The strategy of the search consisted of the varying usage of keywords, such as palatogingival groove, radicular groove, palatal groove, radicular lingual groove, distolingual groove, vertical developmental radicular groove, cingulo radicular groove, developmental radicular anomaly, an interruption groove, corono radicular groove, syndesmo corono radicular tooth, diagnostic, diagnosing, detect, detection, recognition and controlled predefined Medical Subject Heading (MeSH) terms and free terms while using the Boolean operators (i. e., or, and), following the syntax rules of each electronic database for identification of relevant studies. Furthermore, additional manual search was conducted from included publications' reference lists, similar or related to our topic articles. PROSPERO registration ID -CRD42024519645.

Study Selection

The research was conducted stepwise. First, after initiating research in mentioned databases and using previously described keywords, articles that were relevant to the topic were acquired. Duplicates were removed using software reference manager (Zotero 5.0 ®) Secondly, the titles and abstracts of the articles were screened by the authors (G.V. and R.B.). The third step of the research consisted of the revision of the full-text articles that were selected in the first phase. The studies that did not meet the inclusion criteria, were automatically excluded. During the final step, the studies that had all the required inclusion criteria were included in this systematic review. In case of discordance, an additional review was conducted by for the finalization of the decision including a third (A.M.), if necessary, a fourth and fifth (R.V. and N.S.) reviewer.

Data Collection Process

The extraction of the data in the chosen studies was performed using premade Cochrane data extraction templates as guideline (1) information regarding author(s) and publication data of the study | (i.e., year and country), study type, (2) patient's age and

(3) sex, (4) anatomical location of the anomaly (tooth no.), (5) clinical presentation, (6) reported symptoms, (7) duration of re-reported symptoms, (8) modalities used for diagnosing anomaly [15-17].

Risk of Bias Assessment

The risk of bias was assessed by two reviewers (G.V. and R.B.) using Joanna Briggs Institute Critical Appraisal Checklist - University of Adelaide tool for case reports and case series [18,19]. The included case reports and case series were assessed according to the parameters such as: description of patient's characteristics, provided medical history and current clinical condition of the patient, diagnostic tests or assessment methods used, the provided results, post-intervention clinical condition, adverse events and lessons presented by the case report. This systematic review presented a detailed qualitative synthesis of the results presented by the included studies.

Statistical Analysis

The collected data was incorporated and assessed using Microsoft Excel 2019, statistical analysis was acquired using SPSS Statistics data analysis package for Windows, Version 22.0 (IBM, Armonk, New York, USA). Nonparametric Spearman's (rs) and Kendall rank correlation (rk) coefficients, Mann-Whitney U Test and Chi-square test was used by statistic to evaluate significant correlations between analyzed data in our study. $P \leq 0.05$ was considered as the level of significance. Odds ratio (OR) value risk estimation was also conducted in a table with 95% confidence interval (CI). If the 95% CI for an OR excluded 1.0, then the OR was considered to be statistically significant at the 5% level.

Results

Study Selection

During initial search in electronic databases 721 studies were acquired and after the removal of 142 duplicates 580 were identified as relevant to the research topic. Next phase consisted of screening the titles and abstracts of the maintaining studies. 103 studies were assessed for eligibility in phase three. After full text screening while taking inclusion and exclusion criteria into consideration and sub-sequent to analysis of reference list of records identified from databases a total of 54 studies were append into this systematic review. Summarized study selection is portrayed in Fig. 1.

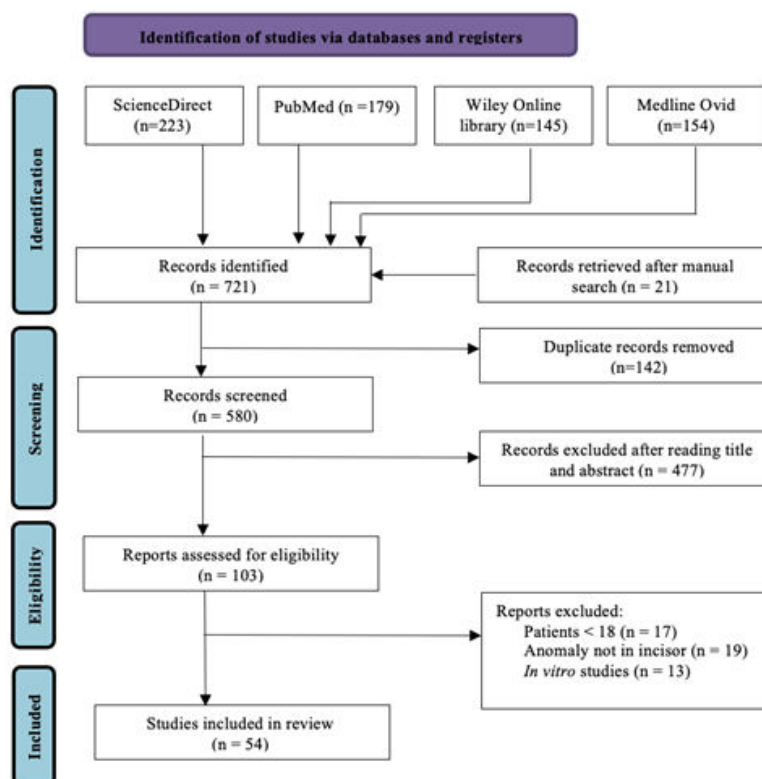


Figure 1: Prisma flow chart.

Study Type and Origin

This systematic review was conducted according to analysis of 46 case reports and 8 case series included, thus consisting information from 67 differing case presentations published between 1978 and 2023, most commonly occurring in India (n = 29/44,62%), USA (n = 8/12,31%) and China (n = 8/12,31%) Table 1.

General Distribution of Sociodemographic Data of Results

According to the results occurrence of PGG was nearly equitably distributed between women (n = 32 cases /49,23%) and men (n = 30 cases/46,15%) in our study. Preponderance of participants appertained to age group of 18-29 years (n = 35/53,85%) with a mean age of 31.31 ± 9.54 years old (ranging from 18 to 69 years old) Table 1.

General Distribution of Symptomatology and Clinical Features

Included studies execute research on 67 maxillary incisors (Table 1). In the majority of analyzed research articles, PGG was detected in maxillary right (n = 35/52,24%) or left (n = 28/41,80%) lateral incisor. Most cases included in this systematic review reported appearance of symptomatology (n = 63/94,03%), duration of the symptoms varied from 2 days to 72 months with an average mean of 9.41 ± 15.66 months. Main symptoms included increased tooth mobility (n = 32/47,76%), appearance of purulent discharge (n = 27/40,30%) and sinus tract (n = 26/38,81%), however no prior treatment (n = 51/76,12%) was noted in majority of cases. Clinical examination was applied to all the teeth of our research subjects, yet in extensive number of cases periodontal pocket probing was common (n = 65/97,01%) with an average mean of 9.14 ± 2.30 mm. Painful vertical percussion (n = 27/40,30%) was also quite prominent during clinical evaluation.

General Distribution of Types of Roentgenological Modalities Used

Roentgenological examination was used in all cases. Intraoral Periapical Roentgenogram (IPR) was the main modality used in included cases (n = 64/95,52%). Notably, CBCT was applied for approximately one-fifth of the cases (n = 12/17,91%). For a third of the studied population (n = 21/31,34%) 2 roentgenological diagnostic modalities were combined to permit conventional differential diagnostic and recognition of the anomaly. Combinations of IPR and sinus tracking (ST) (n = 12/17,91%), IPR and CBCT (n = 8/11,94%) were the most frequent.

General Distribution of Types of Pulp Testing Usage

Pulp vitality was tested for majority of the cases (n = 51/76,12%). Thermal (n = 27/40,30%) and electrical (n = 28/41,79%) tests were accommodated for a little less than half of the cases combining both (n = 19/28,36%) or using only one of them (n = 17/25,37%). In major part of cases where pulp vitality was tested using thermal, electrical tests or in cases were used test was not named precisely negative response was commonly acquired as it was adversely affected (n = 21/31,34%, n = 24/35,82% and n = 4/5,97% respectively). Thorough information about general result distribution is portrayed in the Table 1.

Variable	N (%)	Source
Sex	67 (100)	[3,4,6,9-11,13,20-67]
Female	30 (44,78)	[4,6,10,13,19,21-23,25-28,35,36,38,42,44,46,49,50,53,54,59,60,64-67]
Male	34 (50,75)	[3,4,11,20,24,29-33,37,39-41,45,47,48,51,56-58,61,63,64,67]
No Information	3 (4,48)	[34,43,55]
Age group (years) Average (31.31± 9.54 years)	67 (100)	[3,4,6,9-11,13,20-67]
18-29	36 (53,73)	[3,4,10,13,21,24,26,28,31,33-36,38-40,42,43,46,48,49,52,54,55,57,60-65]
30-39	17 (25,37)	[6,20,25,29,37,40,41,44,45,47, 51,53,58,59,67]
40-49	11 (16,42)	[6,11,23,27,32,40,50,64]
50-59	2 (2,99)	[56,66]
60-69	1 (1,49)	[22]
Country	67 (100)	[3,4,6,9-11,13,20-67]
South America	4 (5,97)	[31,55,66]

North America	8 (11,94)	[22,38,52,54,58-60]
Europe	7 (10,45)	[6,13,27,39,51,53]
Asia	48 (71,64)	[3,4,10,11,20,21,23-26,28-30,32-37,40,41-50,56,57,61-65,67]
Anatomical location	67 (100)	[3,4,6,9-11,13,20-67]
Upper right central incisor (tooth no. 11)	1 (1,49)	[62]
Upper right lateral incisor (tooth no. 12)	35 (52,24)	[3,6,10,11,13,20,27-29,31,32,35-37,40-43,46,49,52,53,56,59-61,63,64,66,67]
Upper left central incisor (tooth no. 21)	3 (4,48)	[4,24,55]
Upper left lateral incisor (tooth no. 22)	28 (41,80)	[3,4, 20-23,25,26,30,33,34,38-40,44,45,47,48,50,51,54,57,58,64,65,67]
Prior treatment	67 (100)	[3,4,6,9-11,13,20-67]
Yes	16 (23,88)	[6,9, 10,12,13,22,23,29,30,37,53,59,67]
No	51 (76,12)	[3,4,6,11,20, 21,24-28,31-36,38-52,54-58,60-64,66]
Symptomatology	67 (100)	[3,4,6,9-11,13,20-67]
Yes	63 (94,03)	[3,4,6,9-11,13,20-31,33,35-47,49-58,60-67]
No	4 (5,97)	[32,34,48,59]
Reported duration of symptoms	67 (100)	[3,4,6,9-11,13,20-67]
Average (9,17 months ±)		
≤1 month	13 (19,40)	[3,11,20,21,28,30,31,37,49,56,62,67]
2-3 months	5 (7,46)	[20,24,36,46,50]
4-6 months	9 (13,43)	[4,10,26,35,40,41,43,61,66]
7-12 months	3 (4,48)	[29,42,52]
≥13 months	7 (10,45)	[13,23,47,54,62,67]
No information	30 (44,78)	[4,6,20,22,25,27,32-34,38-40,44,48,51,53,55,57-59,60,61,63-65]
Clinical features	67 (100)	[3,4,6,9-11,13,20-67]
Increased tooth mobility	32 (47,76)	[3,4,7,11,20-22,24,25,29-32,35,37,38,40,41,43,45,47,50,55,62,64]
Purulent discharge	27 (40,30)	[10,20,23, 24,26,28,30,31,34-36,38,41,46-50,52,53,57,61,62,66,67]
Sinus tract	26 (38,81)	[3,10,11,23,26,27,30,33,36,37,45,47,49-52,57,61,64,66,67]
Swelling	16 (23,88)	[3,10,55-57,61,63,20,23,31,36,38,47,53,54]
Gingival inflammation	8 (11,94)	[19,20,24,31,37,39,47,62]
Additional root formed by PGG	8 (11,94)	[13,23,25,30,45,53,58,65]
Tooth discoloration	7 (10,45)	[3,23,29,35,37,43]
Abscess	6 (8,96)	[6,11,13,54,55,63]
Edemous gingiva	6 (8,96)	[20,24,37,47,55]
Bleeding gums	6 (8,96)	[4,20,40,42]
Increased tooth sensitivity	2 (2,99)	[46,60]
Gingival Pigmentation	2 (2,99)	[28,56]
Odor	1 (1,49)	[22]

Clinical examination	67 (100)	[3,4,6,9-11,13,20-67]
Periodontal pocket probing	65 (97,01)	[3,4,6,9-11,13,21-65,67]
Painful vertical percussion	27 (40,30)	[3,6,10, 11,13,21,27,28,33,34,38,41,44,47,48,52,55,57,58,60,61,65-67]
Bleeding while probing	10 (14,93)	[6,10,31,32,38,47,53,54,62,66]
Painful palpation	9 (13,43)	[10,13,30,38,41,55,67]
Roentgenological examination	67 (100)	[3,4,6,9-11,13,20-67]
IPR	64 (95,52)	[3,4,6,9-11,13,20-25,27-41,43-53,55-67]
ST	19 (28,36)	[23,24,26, 28,30,31,33,36,38,42,44,46,48,50,52,57,61,66]
CBCT	12 (17,91)	[3,11,13,20,22,25,46,48,67]
Occlusal roentgenograph	2 (2,99)	[33,41]
OPG	1 (1,49)	[11]
No information	1 (1,49)	[54]
No. of Roentgenological modalities used per case	67 (100)	[3,4,6,9-11,13,20-67]
1 modality	39 (58,21)	[4,6,10, 20,21,26,29,30,32,34,35,37,39,40,42,46-49,51,52,55,56,58-60,62-65]
IPR	37 (55,22)	[4,6,10, 20,21,29,30,32,34,35,37,39,40,46-49,51,52,55,56,58-60,62-65]
ST	2 (2,99)	[26,42]
2 modalities	21 (31,34)	[3,12,22-25, 28,31,36,38,41,44,50,52,57,61,66,67]
IPR and CBCT	8 (11,94)	[3,13,22,25,67]
IPR and ST	12 (17,91)	[23,24, 28,31,36,38,44,50,52,57,61,66]
IPR and OR	1 (1,49)	[41]
3 modalities	6 (8,96)	[11,30,33,46,48,54,61]
IPR, CBCT and ST	3 (4,48)	[30,46,48]
IPR, CBCT and OPG	1 (1,49)	[11]
IPR, ST and OR	1 (1,49)	[33]
IPR, ST and Spiral-CT	1 (1,49)	[61]
No information	1 (1,49)	[54]
Periodontal pocket depth	65 (97,01)	[3,4,6,9-11,13,21-65,67]
Average (9,14 ± 2,30 mm)		
5-8 mm	25 (37,31)	[4,20,25,29,30,35,37,40,41,44,46,49,52-55,58-61,65]
9-12 mm	32 (47,76)	[3,6,11,20-24,26-28,31-34,36,38,42,43,45,47,48,50,51,56,61-64,67]
≥ 13 mm	6 (8,96)	[3,6,10,20,64,67]
No pocket	2 (2,99)	[13,39]
Tooth mobility	63 (94,03)	[3,4,9-11,13,21,22,24-38,41-48,50,55,62-67]
within physiological limits	16 (23,88)	[10,13, 26-28,34,42,44,46,48, 65-67]
I degree	14(20,90)	[4,11,20,22,24,25,29,30,32,35,37,41,62,64]
II degree	10 (14,93)	[3,4,7,21,31,45,47,64]
III degree	4 (5,97)	[3,40,50]
Inaccurate information	4 (5,97)	[20,38,43,55]
Pulp vitality testing	51 (76,12)	[3,4,6,11,13,20,21,24-28,31-36,38-43,45-53,55-62,64,65,67]
<i>Thermal test</i>	27 (40,30)	[3,13, 21,24-27,32,36,38-40,42,45,46,49,51,52,57,58,60-62,64,65]
Positive	6 (8,96)	[32,38,42,46,60,62]
Negative	21 (31,34)	[3,13, 21,24-27,36,39,40,45,49,51,52,57,58,61,64,65]
<i>Electrical test</i>	28 (41,79)	[4,11,13, 21,24-28,32,35,36,39,42,43,45,46,49-52,56-58,13,61,65,67]

Positive	4 (5,97)	[32,42,46,56]
Negative	24 (35,82)	[4,11,13,21,24-28,35,36,39,43,45,49-52,57,58,61,65,67]
<i>Inaccurate information</i>	15 (22,38)	[6,20,31,33,34,40,41,47,48,53,55,59,67]
Positive	4 (5,97)	[6,20,31,40]
Negative	11 (16,42)	[20,33,34,41,47,48,53,55,59,67]
Both methods (thermal and electrical)	19(28,36)	[13,21,24-27,32,36,39,42,45,46,49,51,52,57,58,61,66]
Only thermal	9(13,43)	[3,38,40,50,56,64]
Only electrical	8(11,94)	[4,11,28,35,43,50,56,64]
IPR-Intraoral Periapical Roentgenogram; CBCT-Cone Beam Computed Tomography; ST-Sinus Tracking; OPG-Orthopantomography; OR-Occlusal Roentgenogram; Inaccurate information -study only informs of test result without naming test applied		

Table 1: General distribution of results.

Distribution of Clinical Features According to Probing Depth of Perio-Dontal Pocket

After analysis (Table 2) it was salient to accentuate that for a major part of the participants with a probing depth of 9-12 mm (n = 32/47,76%) pain and/or sensitivity (n = 16/23,88%), increase in tooth mobility (n = 16/23,88%), sinus tract (n = 16/23,88%) and purulent discharge (n = 15/22,39%) were the most distinguishable symptomatic features characterizing the existence of anomaly independently to having acquired previous treatment or not.

Distribution of Used Roentgenological Modalities According to Probing Depth of Periodontal Pocket

For an extensive quantity of subjects with periodontal pocket depth of 5-8 mm IPR was applied as main diagnostic method (n =19/28,36%), as in the category of deeper probing depth of 9-12mm IPR was also used (n=14/20,89%), yet conjugation of IPR with other modalities, such as ST (n =7/21,86%) or CBCT was also used (n =7/21,86%).

Distribution of Pulp Testing According to Probing Depth of Periodontal Pocket

Differing results were acquired while analyzing results of pulp vitality. Negative response percentage was the highest among the group of the probing depth of 9-12 mm (n = 27/40,3%) followed by the group of 5-8 mm (n = 18/26,87%). Comprehensive description of results is portrayed in the Table 2 below.

Variable	Periodontal pocket depth N (%)			
		5-8 mm	9-12mm	13+mm
		25 (37,31)	n= 32 (47,76%)	6 (8,95)
No treatment				
Previous Treatment?				
		6 (8,95)	7 (10,45)	2 (2,98)
Percussion				
		8 (11,94)	12 (17,91)	4 (5,97)
Palpation				
		3 (4,48)	3 (4,48)	2 (2,98)
Tooth mobility				
Sum				
		11 (16,42)	16 (23,88)	3 (4,48)
I0				
		7 (10,45)	6 (8,95)	1 (1,49)
II °				
		1 (1,49)	6 (8,95)	2 (2,98)
III °				
		2 (2,98)	2 (2,98)	-
IN				
		1 (1,49)	2 (2,98)	-
Bleeding On Probing N				
		2 (2,98)	6 (8,95)	1 (1,49)
(%)				
Pain/Sensitivity N (%)				
		16 (23,88)	16 (23,88)	2 (2,98)

Sinus Tract N (%)		5 (7,46)	16 (23,88)	4 (5,97)
Purulent Discharge N (%)		7 (10,45)	15 (22,39)	3 (4,48)
Swelling N (%)		4 (5,97)	9 (13,43)	2 (2,98)
Roentgenological modalities				
IPR		25 (37,31)	30 (44,78)	6 (100,00)
CBCT		1 (1,49)	8 (11,94)	2 (2,98)
ST		3 (4,48)	4 (5,97)	-
OPG		-	1 (1,49)	-
Spinal-CT		-	1 (1,49)	-
OR		1 (1,49)	1 (1,49)	-
1	Sum	19 (28,36)	14 (20,89)	4 (5,97)
	ST	-	2 (2,98)	-
	IPR	19 (28,36)	12 (17,91)	4 (5,97)
	Sum	5 (7,46)	11 (16,42)	2 (2,98)
2	IPR / CBCT	1 (1,49)	4 (5,97)	2 (2,98)
	IPR/ST	3 (4,48)	7 (10,45)	-
	IPR / OR	1 (1,49)	-	-
	Sum	-	6 (8,95)	-
3	IPR / CBCT / OPG	-	1 (1,49)	-
	IPR / CBCT / ST	-	2 (2,98)	-
	IPR / OR / ST	-	2 (2,98)	-
	IPR / ST / Spinal-CT	-	1 (1,49)	-
Additional clinical features				
Sum		19 (28,36)	16 (23,88)	3 (4,48)
Gingival Inflammation		3 (4,48)	5 (7,46)	-
Edemious Gingiva		2 (2,98)	3 (4,48)	1 (1,49)
Add. Root		6 (8,95)	2 (2,98)	-
Tooth Disc.		3 (4,48)	4 (5,97)	1 (1,49)
Abscess		2 (2,98)	2 (2,98)	1 (1,49)
Gingival Pigment		-	2 (2,98)	-
Bleeding Gums		3 (4,48)	3 (4,48)	-
Odour		-	1 (1,49)	-
Facial Parulis		-	1 (1,49)	-
Teeth Sensitivity		2 (2,98)	-	-
Fenestration		1 (1,49)	-	-
Pulp testing				
Electrical	-	7 (10,45)	14 (20,89)	-
	+	1 (1,49)	4 (5,97)	-
	-	7 (10,45)	9 (13,43)	1 (1,49)
Thermal	+	2 (2,98)	4 (5,97)	-
	-	4 (5,97)	4 (5,97)	1 (1,49)
	+	1 (1,49)	2 (2,98)	1 (1,49)
No information		8 (11,94)	6 (8,95)	2 (2,98)
Duration of symptoms				

<Month	4 (5,97)	8 (11,94)	1 (1,49)
≤3 Months	1 (1,49)	4 (5,97)	-
3-6 Months	4 (5,97)	3 (4,48)	1 (1,49)
7-12 Months	2 (2,98)	1 (1,49)	-
≥13 Months	1 (1,49)	4 (5,97)	1 (1,49)
Symphomathology			
Was observed	24 (35,82)	29 (43,28)	6 (8,95)
Was not observed	1 (1,49)	3 (4,48)	-

Table 2: Distribution of results according to periodontal pocket depth.

Distribution of ST Usage

While estimating the data of Table 3, it was noted that besides previously analyzed usage of IPR, ST was applied in almost a third of included cases (n = 19/28,36%). Vaster portion was used in addition to IPR (n = 12/17,91%) or CBCT (n= 8/11,94%). Preponderance of them appertained to the category of 9-13 mm probing depth (n = 14/20,90%). In more than a half of studied cases where ST was applied purulent discharge was noted (n =13/19,40%) painful percussion (n =10/14,93%) and pain or sensitivity (n =12/17,91%) was evident. In almost a half of studies from this group (n = 9/13,43%) additional characteristics were prominent.

Distribution of CBCT Usage

After analysis quite prominent usage of CBCT was also eminent. It is noteworthy, that CBCT was invariably combined with IPR in 12 cases (100%) (Table 3). In relation to that, it was eminent that in majority of cases CBCT was used when probing depth of periodontological pocket was 9-12 mm (n =8/11,94%), sinus tract was evident (n =8/11,94%), there was an increase of tooth mobility (n=7/10,45%) and supplementary clinical features could be observed (n=8/11,94%).

Distribution of Other Modalities Usage

Few rarer modalities were used in the studies included in our research, yet no distinguishable features accompanied those modalities. Extensive information of our study results is portrayed in Table 3.

Variable	IPR n=64 (95,52)	CBCT n=12 (17,91)	ST n=19 (28,36)	OPG n=1 (1,49)	Spi- ral- CT n=1 (1,49)	OR n=2 (2,99)	1 roengenological modality n=39 (100%)			2 roengenological modalities n=21 (100%)				3 roengenological modalities n=6 (100%)				
							SM	ST n=2 (2,99)	IPR n=37 (55,22)	SM	IPR CBCT n=8 (11,94)	IPR ST n=12 (17,91)	IPR OR n=1 (1,49)	SM	IPR CBCT n=1(1,4 9)	IPR CBCT n=3 (4,48)	IPR OR ST n=1 (1,49)	IPR ST Spiral- CT n=1 (1,49)
Previous Treatment? N (%)	16 (23,88)	5 (7,46)	1 (1,49)	-	-	-	10 (14,93)	-	10 (14,93)	6 (8,96)	5 (7,46)	1 (1,49)	-	-	-	-	-	-
Percussion N (%)	27 (40,30)	8 (11,94)	10 (14,93)	1 (1,49)	-	2 (2,99)	11 (16,42)	-	11 (16,42)	13 (19,40)	6 (8,96)	6 (50,0)	1 (1,49)	3 (4,48)	1 (1,49)	2 (2,99)	-	-
Palpation N (%)	9 (13,43)	4 (5,97)	1 (1,49)	-	-	1 (1,49)	3 (4,48)	-	3 (4,48)	6 (8,96)	4 (5,97)	1 (1,49)	1 (1,49)	-	-	-	-	-
Tooth mobility N (%)																		
SM	32 (47,76)	7 (10,45)	7 (10,45)	1 (1,49)	-	2 (2,99)	19 (28,36)	-	19 (28,36)	8 (11,94)	4 (5,97)	4 (5,97)	1 (1,49)	4 (5,97)	1 (1,49)	2 (2,99)	1 (1,49)	-
I	14 (20,90)	3 (4,48)	1 (1,49)	1 (1,49)	-	1 (1,49)	9 (13,43)	-	9 (13,43)	3 (4,48)	2 (2,99)	1 (1,49)	1 (1,49)	1 (1,49)	1 (1,49)	-	-	-
II	10 (14,93)	2 (2,99)	3 (4,48)	-	-	1 (1,49)	6 (8,96)	-	6 (8,96)	2 (2,99)	1 (1,49)	1 (1,49)	-	2 (2,99)	-	1 (1,49)	1 (1,49)	-
III	4 (5,97)	1 (1,49)	1 (1,49)	-	-	-	2 (2,99)	-	2 (2,99)	2 (2,99)	1 (1,49)	1 (1,49)	-	-	-	-	-	-
In	4 (5,97)	1 (1,49)	2 (2,99)	-	-	-	2 (2,99)	-	2 (2,99)	1 (1,49)	-	1 (1,49)	-	1 (1,49)	-	1 (1,49)	-	-
Physiological norm.	14 (20,90)	5 (7,46)	7 (10,45)	-	-	-	7 (10,45)	2 (2,99)	5 (7,46)	7 (10,45)	4 (5,97)	3 (4,48)	-	2 (2,99)	-	1 (1,49)	-	1 (1,49)
X	18 (26,87)	-	8 (11,94)	-	-	-	13 (19,40)	-	13 (19,40)	5 (7,46)	-	5 (7,46)	-	-	-	-	-	-
Clinical features N (%)																		
Bleeding On Probing N (%)	9 (13,43)	-	3 (4,48)	-	-	-	6 (8,96)	-	6 (8,96)	3 (4,48)	-	3 (4,48)	-	-	-	-	-	-
Pain/Sesitivity N (%)	33 (49,25)	3 (4,48)	12 (17,91)	-	1 (1,49)	2 (2,99)	23 (34,33)	1 (1,49)	22 (32,84)	6 (8,96)	2 (2,99)	5 (7,46)	1 (1,49)	3 (4,48)	-	1 (1,49)	1 (1,49)	1 (1,49)
Sinus Tract N (%)	26 (38,81)	8 (11,94)	19 (28,36)	1 (1,49)	1 (1,49)	1 (1,49)	10 (14,93)	1 (1,49)	9 (13,43)	12 (17,91)	5 (7,46)	7 (10,45)	-	5 (7,46)	1 (1,49)	2 (2,99)	1 (1,49)	1 (1,49)
Purulent Discharge N (%)	27 (40,30)	4 (5,97)	13 (19,40)	-	1 (1,49)	1 (1,49)	12 (17,91)	1 (1,49)	11 (16,42)	13 (19,40)	3 (4,48)	9 (13,43)	1 (1,49)	2 (2,99)	-	1 (1,49)	-	1 (1,49)

Swelling N (%)	14 (20,90)	1 (1,49)	6 (8,96)	-	-	-	8 (11,94)	-	8 (11,94)	7 (10,45)	1 (1,49)	6 (8,96)	-	-	-	-	-	-
Periodontal pocket depth N (%)																		
5-8	24 (35,82)	1 (1,49)	6 (8,96)	-	-	1 (1,49)	19 (28,36)	-	19 (13,43)	5 (7,46)	1 (1,49)	3 (4,48)	1 (1,49)	-	-	-	-	-
9-12	30 (44,78)	8 (11,94)	14 (20,90)	1 (1,49)	1 (1,49)	1 (1,49)	15 (22,39)	2 (2,99)	13 (19,40)	11 (16,42)	4 (5,97)	7 (10,45)	-	6 (8,96)	1 (1,49)	3 (4,48)	1 (1,49)	1 (1,49)
13+	6 (8,96) (16,67)	2	-	-	-	-	5 (7,46)	-	4 (5,97)	2 (2,99)	2 (2,99)	-	-	-	-	-	-	-
No pocket	2 (2,99)	1 (1,49)	-	-	-	-	1 (1,49)	-	1 (1,49)	1 (1,49)	1 (1,49)	-	-	-	-	-	-	-
IN	2 (2,99)	-	2 (2,99)	-	-	-	-	-	-	2 (2,99)	-	2 (2,99)	-	-	=	-	-	-
Additional clinical features N (%)																		
SM	6 (8,96)*	8 (11,94)*	9 (13,43) *	1 (1,49)*	1 (1,49) *	.*	24 (35,82)*	1 (1,49) *	23 (34,33)*	10 (14,93)*	5 (7,46)*	5 (7,46)*	.*	4 (5,97)*	1 (1,49))*	2 (2,99)*	.*	1 (1,49)*
Gingival Inflammation	8 (11,94)	-	2 (2,99)	-	-	-	6 (8,96)	-	6 (8,96)	2 (2,99)	-	2 (2,99)	-	-	-	-	-	-
Edemioius Gingiva	6 (8,96)	-	1 (1,49)	-	-	-	5 (7,46)	-	5 (7,46)	1 (1,49)	-	1 (1,49)	-	-	-	-	-	-
Add. Root	8 (11,94)	3 (4,48)	3 (4,48)	-	-	-	4 (5,97)	-	4 (5,97)	3 (4,48)	2 (2,99)	1 (1,49)	-	1 (1,49)	-	1 (1,49)	-	-
Tooth Disc.	7 (10,45)	3 (4,48)	2 (2,99)	-	-	-	4 (5,97)	-	4 (5,97)	3 (4,48)	2 (2,99)	1 (1,49)	-	1 (1,49)	-	1 (1,49)	-	-
Abscess	5 (7,46)	2 (2,99)	-	1 (1,49)	-	-	3 (4,48)	-	3 (4,48)	3 (4,48)	1 (1,49)	1 (1,49)	-	1 (1,49)	1 (1,49)	-	-	-
Gingival Pigmentation	2 (2,99)	-	1 (1,49)	-	-	-	1 (1,49)	-	1 (1,49)	1 (1,49)	-	1 (1,49)	-	-	-	-	-	-
Bleeding Gums	4 (5,97)	-	2 (2,99)	-	-	-	5 (7,46)	1 (1,49)	4 (5,97)	0 (0,0)	-	-	-	-	-	-	-	-
Odour	1 (1,49)	1 (1,49)	-	-	-	-	-	-	-	1 (1,49)	1 (1,49)	-	-	-	-	-	-	-
Facial Parulis	2 (2,99)	-	2 (2,99)	-	1 (1,49)	-	-	-	-	1 (1,49)	-	1 (1,49)	-	1 (1,49)	-	-	-	1(1,49)
Teeth Sensitivity	2 (2,99)	-	1 (1,49)	-	-	-	-	-	2 (2,99)	-	-	-	-	-	-	-	-	-
Fenestration	1 (1,49)	-	-	-	-	-	-	-	1 (1,49)	-	-	-	-	-	-	-	-	-
Pulp testing N (%)																		
EL.	-	23 (34,33)	6 (8,96)	13 (19,40)	1 (1,49)	1 (1,49)	-	10 (14,93)	-	10 (14,93)	9 (13,43)	2 (2,99)	7 (10,45)	-	4 (5,97)	1 (1,49)	-	1 (1,49)
	+	3 (4,48)	-	1 (1,49)	-	-	-	4 (5,97)	1 (1,49)	3 (8,11)	-	-	0 (0,0)	-	-	-	-	-
Therm.	-	20 (29,85)	6 (8,96)	11 (16,42)	-	1 (1,49)	-	8 (11,94)	1 (1,49)	7 (10,45)	10 (14,93)	4 (5,97)	6 (8,96)	-	3 (4,48)	-	2 (2,99)	-
	+	5 (7,46)	-	3 (4,48)	-	-	-	5 (7,46)	1 (1,49)	4 (5,97)	1 (1,49)	-	1 (1,49)	-	-	-	-	-

IN.	-	9 (13,43)	-	2 (2,99)	-	-	2 (2,99)	7 (10,45)	-	7 (10,45)	1 (1,49)	-	-	1 (1,49)	1 (1,49)	-	-	-	1 (1,49)
	+	4 (5,97)	-	1 (1,49)	-	-	-	3 (4,48)	-	3 (4,48)	1 (1,49)	-	1 (1,49)	-	-	-	-	-	-
X		15 (22,38)	4 (5,97)	2 (2,99)	-	-	-	9 (13,43)	-	9 (13,43)	6 (8,96)	4 (5,97)	2 (2,99)	-	-	-	-	-	-
Duration Of Symptoms N (%)																			
<Month		10 (14,93)	5 (7,46)	3 (4,48)	1 (1,49)	-	-	3 (4,48)	-	3 (4,48)	5 (7,46)	3 (4,48)	2 (2,99)	-	2 (2,99)	1 (1,49)	1 (1,49)	-	-
<=3 Months		8 (11,94)	-	3 (4,48)	-	-	-	6 (8,96)	-	6 (8,96)	3 (4,48)	-	3 (4,48)	-	-	-	-	-	-
<=6 Months		8 (11,94)	1 (1,49)	4 (21,05)	-	1 (1,49)	1 (1,49)	5 (7,46)	1 (1,49)	4 (5,97)	2 (2,99)	-	1 (1,49)	1 (1,49)	2 (2,99)	-	1 (1,49)	-	1 (1,49)
<=12 Months		2 (2,99)	-	2 (2,99)	-	-	-	2 (2,99)	1 (1,49)	1 (1,49)	1 (1,49)	-	1 (1,49)	-	-	-	-	-	-
>12 Months		6 (8,96)	3 (4,48)	1 (1,49)	-	-	-	2 (2,99)	-	2 (2,99)	4 (5,97)	3 (4,48)	1 (1,49)	-	-	-	-	-	-
X		30 (44,78)	3 (4,48)	9 (47,37)	-	-	1 (1,49)	22 (32,84)	-	22 (32,84)	6 (8,96)	2 (2,99)	4 (5,97)	-	2 (2,99)	-	1 (1,49)	1 (1,49)	-
Symptomatology N (%)																			
Was observed		60 (89,55)	12 (17,91)	18 (26,87)	1 (1,49)	1 (1,49)	1 (1,49)	35 (52,24)	2 (2,99)	33 (49,25)	21 (31,34)	8 (11,94)	12 (17,91)	1 (1,49)	6 (8,96)	1 (1,49)	3 (4,48)	1 (1,49)	1 (1,49)
Was not observed		4 (5,97)	-	1 (1,49)	-	-	1 (1,49)	4 (5,97)	-	4 (5,97)	-	-	-	-	-	-	-	-	-

SM-sum of features in a group; IPR-intraoral periapical roentgenogram; CBCT-Cone beam computed tomography; ST-Sinus Tracking; OPG-Orthopantomography; OR-Occlusal Roentgenogram; X-no information in case; IN-Inaccurate Information; EL-Electrical Pulp Testing; Therm: Thermal pulp testing, + -positive response;-negative response.

Table 3: Distribution of results according to used roentgenological modality.

Statistical data of Symptomatology and Clinical Features

A statistically significant confidence level of 0.05 was chosen for this study. Statistical data of gathered information from analyzed cases state that there was a significant positive correlation between a positive percussion and a positive palpation according to Spearman correlation coefficient ($r_s = 0.33$, $p = 0.006$), meaning that positive percussion was commonly acquired with positive palpation in studied case. However, inverse statistically relevant correlation was prominent between positive percussion and increase of tooth mobility ($r_k = -0.260$, $p = 0.045$) thus implying that positive percussion was rarer if tooth mobility had exceeded physiological norm. Excessive information on other significant correlations apprehending common symptoms of PGG are portrayed in the Table 4.

Variable no.1	Variable no. 2	®	(p)
Palpation	Percussion	0.330	0.006
Increased mobility	Percussion	-0.260	0.045
	Sex*	0.248	0.045
Purulent discharge	Sinus tract	0.035	0.003
Swelling	Bleeding on probing	0,355	0.003
	Gingival alteration	0.359	0.050
	Edemous gingiva	0.241	0.050

	Abcess	0.241	0.050
Bleeding gums	Gingival alteration	0.325	0.007
Bad breath	Bleeding gums	0.284	0.020
Edemous gingiva	Sex	0.273	0.029
Gingival inflammation	Edemous gingiva	0.246	0.045
	Palpation	0.260	0.034
®-correlation coefficient, p-Significance (2-tailed); *-male			

Table 4: PGG symptom correlation according to Spearman correlation coefficient.

It is also noteworthy, that usage of nonparametric Mann-Whitney U test gave insight on other significant characteristic of PGG as it was acclaimed that statistically younger subjects with the average age mean of $27,8 \pm 7,8$ years that were included in the study proclaimed to have experienced pain or sensitivity in comparison to older subjects ($35,4 \pm 10,1$ years) of our study (Fig. 3).

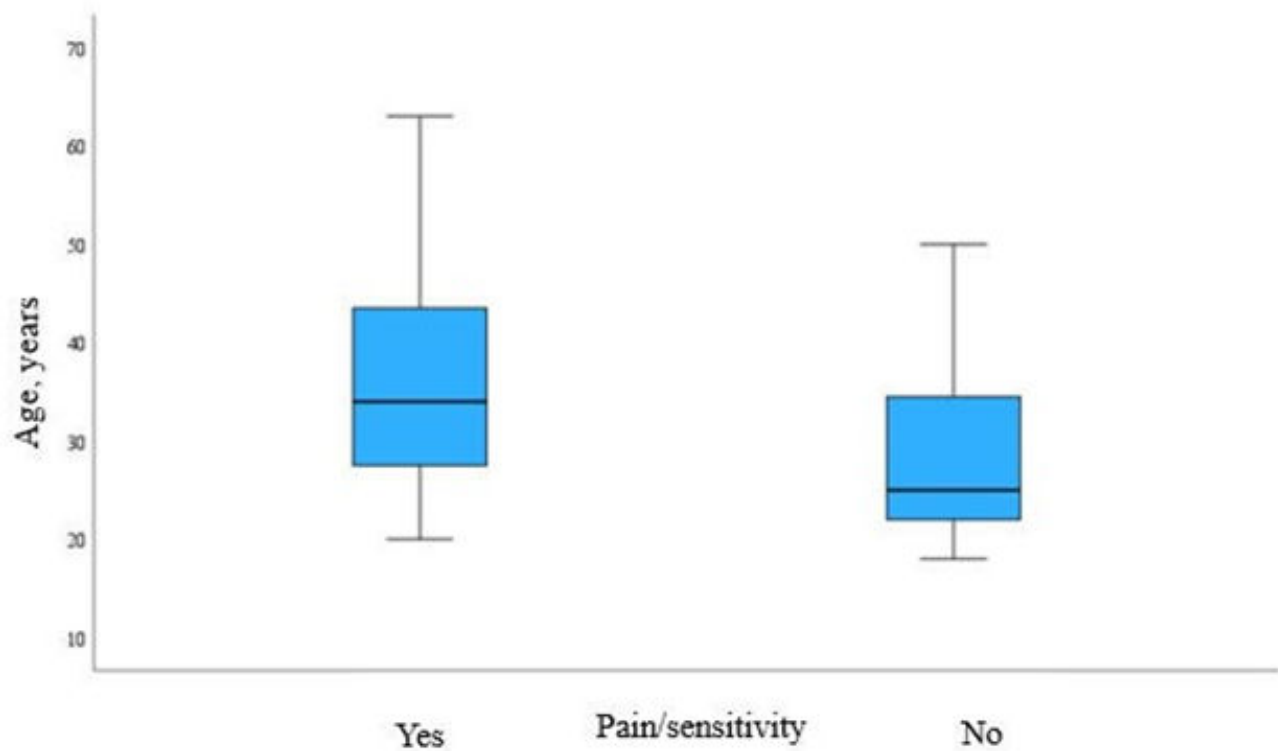


Figure 3: Rectangular plot of patients' age according to pain or sensitivity.

Furthermore, in consonance to Mann-Whitney U test it was also eminent that shallower periodontal pocket was accompanied by existence of additional root more commonly than in those instances where average man of periodontal pocket was $6,38 \pm 1,068$ varying from 5,25 mm to 8,50 mm (Fig. 4).

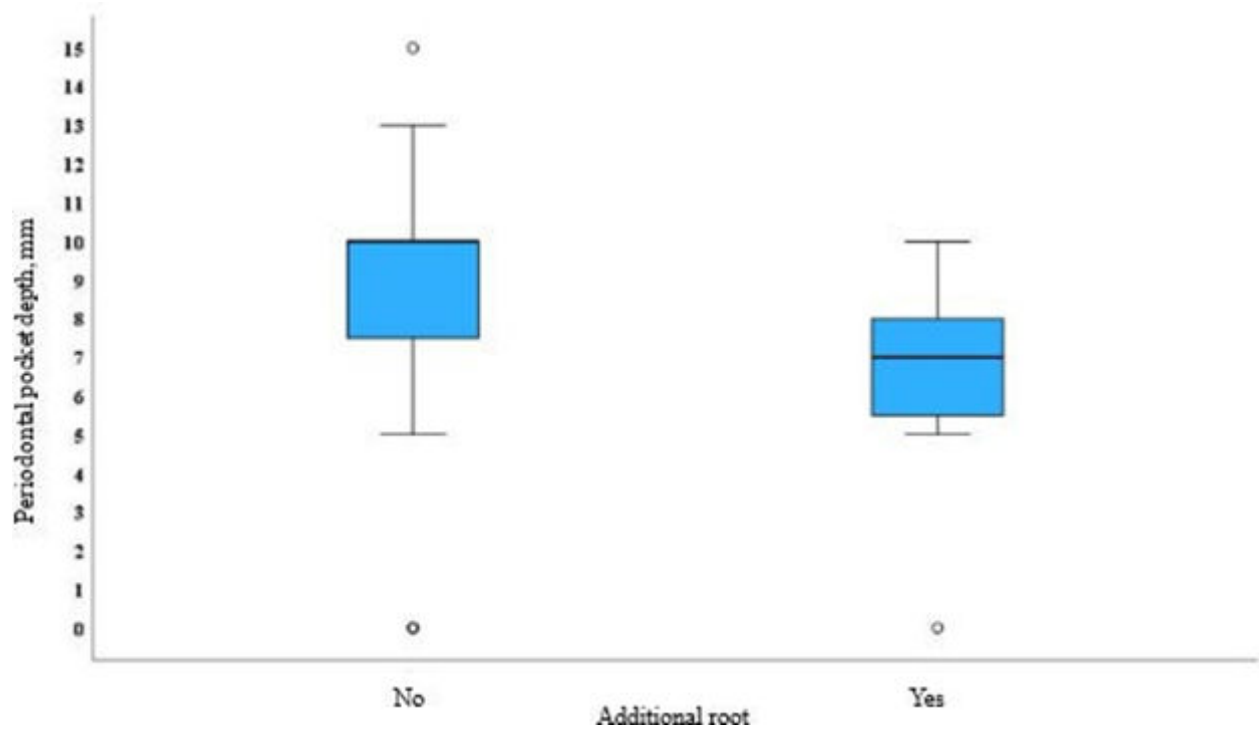


Figure 4: Rectangular plot of periodontal pocket depth according to existence of additional root.

Furthermore, after assessing an odds ratio (OR) it was evident that in coordination with positive significant correlation positive percussion also escalated the prospect of positive palpation (OR = 7,778), however it also plunged probability of increased tooth mobility (OR = 0.252). Insight on the significant prevalence of odds ratio are portrayed in the Table 5.

Variable no. 1	Variable no. 2	Risk estimate	95% Confidence Interval	
		Odd ratio value	Lower	Upper
Pecussiom	Increased mobility	0.252	0.076	0.833
Sex*	Increased mobility	6.071	1.823	20.017
Purulent discharge	Sinus tract	2.813	1.015	7.793
Swelling	Bleeding on probing	7.050	1.674	29.682
Gingival alteration	Swelling	6.000	1.681	21.420
Gingival pigmentation	Palpation	16.286	1.303	23.533
Gingival inflammation	Palpation	5.300	1.015	27.924
Odd ratio value < 1,000 decreases probability; Odd ratio value > 1,000 increases probability				

Table 5: Statistically significant odd ratio estimations of PGG symptoms.

Statistical Data of Roentgenological Modalities

After statistical analysis of the data regarding roentgenological modalities it was noted that there was statistically significant connection between the depth of periodontal pocket and usage of CBCT ($p = 0,033$) in cases studied in our review according to Mann-Whitney Test. The nonparametric test concludes that CBCT was used more when an average mean of periodontal pocket was $9,75 \pm 1,02$ mm, varying from the depth of 9,2 5 mm to 12,00 mm (Fig. 5). Furthermore, statistically relevant positive correlation between the usage of CBCT and appearance of sinus tract was also noted ($r_s = 0,247$, $p = 0,046$).

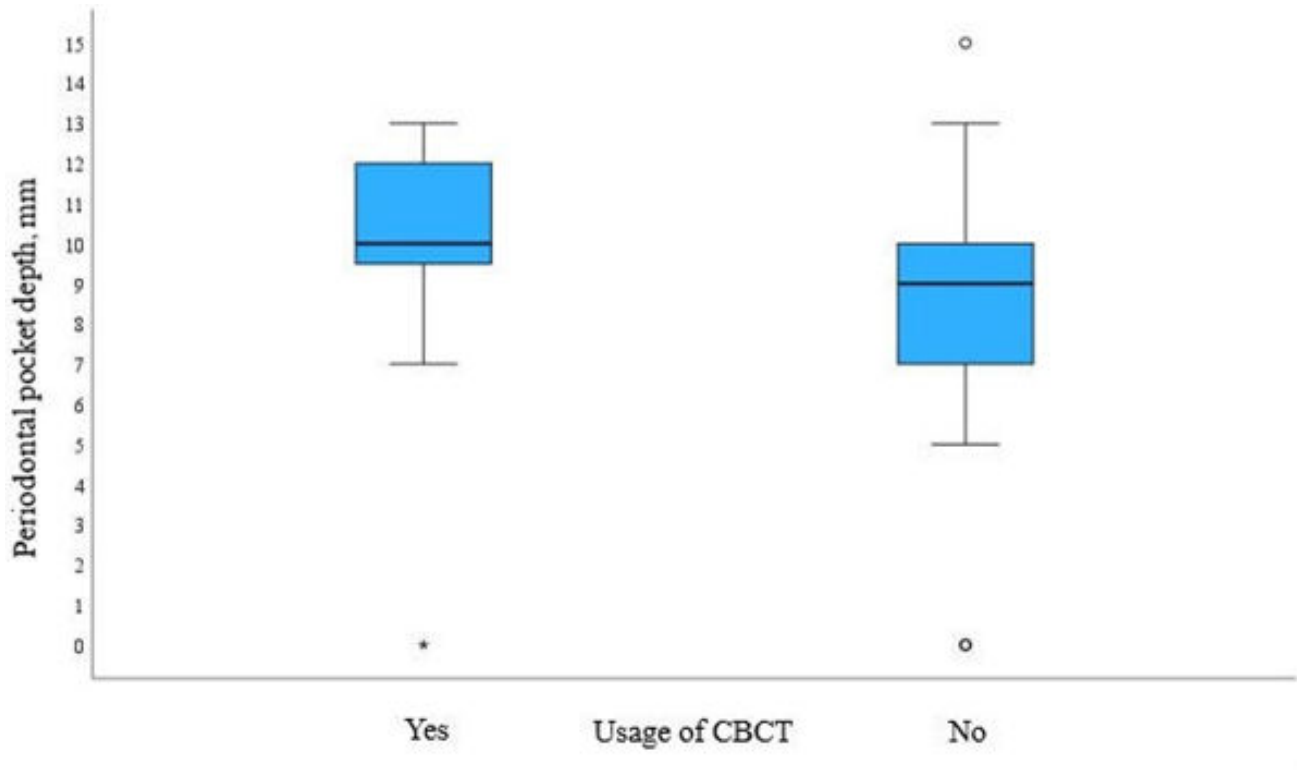


Figure 5: Rectangular plot of patients' periodontal pocket depth according to usage of CBCT.

In addition, Spearman correlation coefficient also emphasized relevant positive correlation between the usage of ST, purulent discharge and sinus tract being evident ($r_s = 0,288$, $p = 0,019$ and $r = 0,288$, $p = 0,019$ respectively). Furthermore, it was noted that both purulent discharge and sinus tract increased probability of ST usage in analyzed cases (OR = 3,657; CI-(1,198-11,162) respectively).

Quality Rating

After the evaluation of the quality of the articles, according to the selected assessment instruments, it was found that out of 46 (68,66%) case studies, the majority consisted of moderate bias ($n = 29/43,28\%$) and low bias ($n = 9/13,43\%$) clinical cases (Appendix Table 1). Almost all of the analyzed clinical case series that consisted of 21 case reports (31,34%) were rated as having moderate bias ($n = 18/26,87\%$) (Appendix Table 2).

Discussion

This study analyzed clinical cases of palatogingival groove as it is a rare anomaly that distinguishes oneself by variety of uncommon symptom combinations and types of exhibition, thus causing its complicated recognition [69]. Kumar Varun with colleagues state that literature is sparse on utilization of diagnostic approaches for diagnosing anomalies such as PGG, whereas study of Zhang, et al., construct that only sparse part of teeth with PGGs are diagnosed during clinical evaluation [2,70]. Consequently, our study aimed to alleviate clinicians the process of recognizing anomaly by distinguishing and evaluating not only distribution and statistical correlations between the main features and accompanying rarer symptoms of PGG that were observed in analyzed cases but also the usage of diagnostic tools in said cases.

First and foremost, analysis of the data of frequencies on 67 cases in our study confirmed findings of R Zhang, et al., as the results of their study also state that the anomaly was more prevailed in the maxillary lateral incisors. However, their study only included participants from Chinese population, whereas our study involved vaster racial population, thus implying that race might not have connection to the anomalies' exhibition location [70]. Furthermore, results of distribution in our study imply that PGG ought to be suspected in case of detection of periodontal pocket in palatal aspect of the tooth averaging $9,14 \pm 2,30$ mm., increased tooth mobility of incisors to 1st or 2nd degree, painful vertical percussion, existence of purulent discharge and sinus tract in damaged area. Nonetheless, it is noteworthy, that despite vertical percussion and increase of mobility being one of the most prominent features of anomaly according to frequency prevalence, statistical data noted inverse correlation between these

characteristics, hence implying the need to examine and evaluate both of these features during clinical assessment. Both of these characteristics are inherent to damaged periodontium which H Yan, et al., in their study suggest are caused by the grooves ability to anatomically portray as retention site for plaque accumulation as it consequently promotes bacterial accumulation leading to previously mentioned breakdown and damage of periodontal and surrounding tissues [67].

Furthermore, distribution of quantitative data in our study suggests that deeper periodontal pocket could potentially imply the existence of additional clinical features that are less commonly acquired when suspecting PGG and could potentially aggravate the process of proper assessment, such symptoms include abscesses, gingival inflammation and edema, tooth discoloration. However, statistical data acquired only one statistically relevant connection opposing deduction composed after assessing quantitative dispersal of data, as it was found that in cases where periodontal pocket was shallower additional root was detected more commonly. Such results might have plausible connection to the findings of X Tan, et al., that were made using 8 samples: periodontal pocket has no distinct relationship with the length of the palatal groove itself, thus making it hard to predict the extent and exhibition of malformation [71].

Furthermore, frequency of data on pulp involvement was also assessed in our study as negative pulp testing result was more commonly expressed in those cases where periodontal attachment was not as severely damaged. Irfan Ansari, et al., study state that PGG has a tendency to lead to complex endodontic-periodontic lesions, however they assert that connection between the pulp and the periodontium with a groove is facilitated by accessory canals running along the groove and not always rely on the extent of anomaly and the damage it has already caused to surrounding tissue thus implying that pulp vitality could stay intact even in very adverse environment and could be damaged in plausibly affected one just like it was evident in our study [12].

As it was previously mentioned, our study also assessed prevalence of diagnostical tools that were used along with clinical evaluation in 67 cases and evaluated quantitative and statistically relevant connections. Evidently, out of 6 different tools that were applied in cases, intraoral periapical roentgenogram was used the most along with clinical examination in our study. I. Ansari, et al., claim that intraoral periapical roentgenogram is practical and cost-effective modality, making it the primary choice for diagnosing PGG [12]. However, Teresa Giner-Lluesma, et al., claim that two-dimensional X-rays may not be sufficient to observe and understand the complex root system of teeth affected by PGG and is lacking in the depth of provided information [13]. Considering quantitative distribution, our study suggests similar conclusion, as it was also quite prominent that in cases where during clinical evaluation deeper periodontal pocket ($\geq 9\text{mm}$) was detected and more immense previously mentioned alterations of gingiva including abscesses, gum inflammation or discoloration along with alterations of tooth itself (discoloration, additional root) were evident roentgenological evaluation consisted of conjunction of two or three modalities. In majority of cases CBCT along with IPR was used for elucidation of diagnosis of PGG, however, it is noteworthy, that CBCT was combined with all of the other modalities reported in our study making it the main modality for clarification. Statistically relevant connection using Mann-Whitney U test was also noted, as results found that CBCT was used more when an average mean of periodontal pocket was $9.75 \pm 1.02\text{ mm}$ thus plausibly suggesting that for a precise diagnosis and visualization of anomaly CBCT is ought to be used. A.I. Aljuailan, et al., and Lekshmi, et al., study also underline that CBCT is the only noninvasive modality which gives precise assessment of location, length, depth, severity, complexity and associated alveolar bone and per-iodontal attachment loss with PGG and can alleviate its early diagnosis [7,72]. R Zhang, et al., study also note the benefits of CBCT in diagnosis of PGG as in their study out of 163 teeth, 85 (52.1%) were diagnosed with PGG only after CBCT examination [70]. However, taking into consideration that CBCT does have higher radiation dosage and findings of our study, this modality should be used only in those cases where expressed symptom type indicates that anomaly caused abundant damage [73].

HJ Kim, et al., claim that clinicians need a detailed understanding of the characteristics of PGG to successfully manage the condition, therefore findings of our study provide purposeful analysis of in vivo data acquired by clinicians themselves and as mentioned before could alleviate the process of diagnosing PGG immensely. The main benefits of our study are that it analyses not only frequency and statistical connections of the most common features of anomaly but includes rarer alterations that commonly mislead and lead to failure of diagnosis. Furthermore, case reports provide guidelines and tips for other clinicians and have high applicability in general practice. However, our data must be interpreted with caution and limitations as the main drawback of our study should be taken into account: analyzed information was obtained from case reports and case series thus lacking objectivity as they are not as precise, employed differing protocols for clinical examination, thus consequently are hard

to be in comparison. The data collected could be biased and cannot be generalized, however it could still be useful for day-to-day practice. General absence of information and studies of PGG makes it difficult to gather precise and explicit data related to this particular malformation of a tooth hence being another drawback of our study. Nevertheless, summary of the data that was available to obtain ought to reduce challenges when facing rare anomalies such as PGG.

Conclusion

The analyzed data suggest that considering quantitative data periodontal pockets averaging $9,14 \pm 2,30$ mm, elevated mobility of I or II degree, painful percussion and purulent discharge detected in maxillary incisors are the main characteristics of PGG, with sparse significant correlations between them. Rarer symptoms could be acquired along mentioned ones, however only one significant revelation was found regarding existence of additional root in analyzed cases. IPR was noted as the main roentgenological modality as should be used firstly when suspecting PGG, yet both quantitative and statistical data suggest that CBCT is ought to be used to alleviate assessment of anomaly as it is commonly exhibited differently yet in majority of cases causes quite abundant amount of damage requiring more thorough appraisal.

Conflict of Interests

The authors have no conflict of interest to declare.

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Appendix

Table 1

Eil.nr	Author, year	Demographic characteristics	Patient history	Clinical condition	Diagnostic tests	Treatment methods	Post-intervention clinical	Adverse events	Recommendations	Evaluation
1.	Hasan A et al. 2018, Pakistan	x	x	+	+	+	+	+	+	Low
2.	Garrido I et al. 2016, Brazil	x	x	+	+	+	+	-	+	Moderate
3.	Yao L et al. 2022, China	x	x	+	+	+	+	+	+	Low
4.	Ling D-H et al. 2022, China	x	x	+	+	+	+	-	+	Moderate
5.	Thapa S et al. 2021, Nepal	x	x	+	+	x	+	-	+	Moderate
6.	Katwal D et al. 2019, USA	x	x	+	+	+	+	-	+	Moderate
7.	Baharin S et al. 2019, Malaysia	x	+	+	+	+	+	-	-	Low
8.	Kumar T et al. 2018, India	x	x	+	x	x	x	x	x	High
9.	Alizadeh Tabari Z Et al. 2016, Iran	x	x	+	+	+	+	x	+	Moderate
10.	Sooratgar A et al. 2016, Iran	x	x	+	+	+	+	x	+	Moderate
11.	Castelo -Baz P et al. 2015, Spain	x	x	+	+	+	+	-	x	Moderate
12.	Sharma S et al. 2015, India	x	x	+	+	+	+	-	+	Moderate
13.	Sharma S et al. 2015, India	x	x	+	+	+	+	-	x	Moderate
14.	Miao H et al. 2015, China	x	x	+	+	+	+	-	x	Moderate
15.	Forero -López J et al. 2015, Columbia	x	x	+	+	+	x	-	x	High
16.	Salari A et al. 2015, Iran	x	x	+	x	+	+	-	+	Moderate
17.	Johns D et al. 2014, India	x	x	+	+	+	+	-	+	Moderate
18.	Thakur S et al. 2014, India	x	x	+	+	+	+	-	+	Moderate
19.	Kishan K et al. 2014, India	x	x	+	+	+	x	-	+	Moderate
20.	Naik M et al.2014, India	x	x	+	+	+	+	x	+	Moderate
21.	Giner-Lluesma T et al. 2020, Spain	x	x	+	+	+	+	-	x	Moderate

22.	Vasanth K et al. 2012, India	x	+	+	+	+	+	-	+	Low
23.	David S. August 1978, USA	x	+	+	+	+	+	-	+	Low
24.	Hipolito Fabra-Campos 1990, Spain	x	x	+	x	+	x	-	x	High
25.	Mittal M et al. 2013, India	x	x	+	+	+	x	x	+	Moderate
26.	Suchetha A et al. 2012, India	x	x	+	+	x	x	-	-	High
27.	Khetarpal A et al. 2012, India	x	x	+	+	+	+	-	x	Moderate
28.	Guruprasad CN et al. 2012, India	x	x	+	+	x	+	x	+	Moderate
29.	Gandhi A et al. 2011, India	x	x	+	+	+	+	-	+	Moderate
30.	Singh A et al. 2011, India	x	+	+	+	+	+	x	+	Low
31.	Elanchezhiyan S et al. 2011, India	x	+	+	+	+	+	-	x	Moderate
32.	Attam K et al. 2010, India	x	x	+	+	+	x	-	+	Moderate
33.	Hans M et al. 2011, India	x	x	+	x	x	x	-	-	High
34.	Ballal N V et al. 2007, India	x	x	+	+	+	x	-	+	Moderate
35.	Zucchelli G et al. 2006, Italy	x	x	+	+	+	+	+	+	Low
36.	Schwartz SA et al. 2006, USA	x	x	+	+	+	+	x	+	Moderate
37.	Schäfer E et al. 2000, Germany	x	+	+	+	+	+	+	+	Low
38.	Andreana S et al. 1998, USA	x	+	+	+	x	+	-	+	Moderate
39.	Cecília MS et al. 1998, Brasil	x	x	+	+	+	+	+	+	Low
40.	Jeng JH et al. 1992, Taiwan	x	x	+	+	+	x	-	+	Moderate
41.	Friedman S et al. 1988, Israel	x	x	+	+	x	+	+	x	Moderate
42.	Peikoff MD et al. 1985, USA	x	x	+	+	x	x	+	+	Moderate
43.	Meister F et al. 1983, USA	x	x	+	x	+	+	x	x	High
44.	D Rachana et al. 2007, India	x	x	+	+	+	x	x	x	High
45.	Gadagi JS et al. 2012, India	x	x	+	x	+	x	x	x	High
46.	Kumar p. et al 2016, India	x	x	+	x	+	x	+	x	High

Table 1: Quality assessment of clinical cases.

Table 2

Eil.nr	Author, year of publication	Inclusion criteria	Methods to apply for	Validity of applied diag-	Randomization of partic-	Description of participant	Patient demographics	Clinical condition of pa-	Results	Demographic area of the	Statistical analysis	Evaluation
1.	Cho Y-D, et al., 2017, South Korea	+	+	+	-	x	x	+	+	-	-	Moderate
2.	Karunakaran J, et al., 2017, India	+	+	+	-	x	x	+	+	-	-	Moderate
3.	Yan H, et al., 2019, China	+	+	+	-	x	+	+	+	x	-	Moderate
4.	Vishnoi SLirkt. 2016, India	x	+	+	-	-	x	+	+	-	-	High
5.	Corbella S, et al., 2019, Italy	x	+	+	-	-	x	+	+	-	-	Moderate
6.	Tong Li, et al., 2023, China	x	+	+	+	+	x	+	+	x	-	Moderate
7.	Hungund S, et al., 2010, India	x	+	+	-	x	x	+	+	x	-	Moderate
8.	Mayne JR, et al., 1990, USA	x	+	+	-	x	x	+	+	-	-	Moderate

Table 2A: Quality assessment of clinical case series.

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