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Review Article

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Prevalence of Curved Root of Permanent Teeth. A Review Study

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Abstract

Curved Root (Root dilaceration) is a dental oddity that occurs during tooth development. Essentially, the root bends or angles in an unusual way. This can cause problems with extractions, endodontic procedures, and orthodontic tooth movement.

Aim of the study: *To assess how common root dilaceration is, where it tends to occur, and what demographic trends exist.*

Materials and Methods: *The review conducted a range of published research found in academic databases; "PubMed, Scopus, Web of Science, and Google Scholar", covering dental abnormalities, especially root dilacerations in teeth, across adult patients aged 18 to 65, male and female alike by thoroughly reviewing available literature and analyzing radiographic records.*

Results: *The prevalence came out to about 4.85%. Posterior tend to be hit hardest. The highest rate recorded was 1.22% in mandibular third molars. Next were mandibular first premolars at 0.63%, then maxillary first molars with 0.58%. The anterior teeth rarely showed this, less than 0.3% in total. There's also a noticeable lean toward mandibular teeth (61.8%) over maxillary ones (38.2%). This might be tied to how teeth develop or their anatomy.*

Conclusion: *The prevalence of root dilacerations in this review was 4.85%. The result underlines the importance of keeping root dilacerations in mind when planning treatments. A contrast worth noting, and they stress the need for careful radiographic checks, especially for teeth more likely to have this condition.*

Keywords: *Root dilaceration, curved root, dental anomaly, endodontic challenges, Tooth extraction complications, tooth root morphology.*

Introduction

Dental anomalies are among the most common problems during tooth development, caused by a mix of genetic and environmental factors. These issues don't just affect permanent teeth; deciduous teeth can be involved too, along with jaw movement disturbances [1]. Various changes in teeth, like their size, number, shape, when they come in, or where they're located, can often be traced back to systemic diseases [2,3]. Root dilaceration is one such anomaly. It happens because of a developmental defect and can affect the root or crown of a tooth [4]. Different studies don't always agree on how to diagnose root dilacerations. Generally, a root dilaceration means there's a sharp bend or curve in the tooth root or crown, usually 90 degrees or more, messing up the usual straight line between crown and root [5].

Root dilaceration has been described by some as a bend or flexion of 20 degrees or more from the tooth's usual axis, specifically in the apical part of the root [6]. Even though trauma accounts for about 11-30% of injuries to deciduous teeth, the occurrence of root dilacerations in permanent teeth remains quite rare [4]. This rarity likely stems from the fact that root dilaceration may cause problems like failure of tooth eruption, prolonged retention of the baby tooth, or even fenestration of the cortical plate at the apex, which makes spotting root dilaceration during clinical exams really important [7]. Looking at anterior dentition, the apical third portion of the root tends to be the most frequently affected by dilacerations, followed by the middle third of the first molars, and lastly the coronal third of the third molars [8]. Root dilacerations tend to happen more often in the back teeth region compared to crown dilacerations [4]. Interestingly, crown dilaceration is seen more frequently in maxillary permanent incisors than in mandibular incisors. Clinically, mandibular incisors tend to tilt labially, whereas maxillary incisors show a lingual tilt [9].

Root dilaceration, well, it makes tooth extraction a tough task. It's often seen as a big challenge for both orthodontic and endodontic treatments [4,7,8]. Crown dilaceration? That can be spotted during a simple intraoral check. But root dilaceration, on the other hand, stays hidden—can't be caught without a radiograph [4]. Panoramic images, along with other common x-rays, have been the usual tools to spot these root curvatures. More recently, though, CBCT has been shown to do a much better job at revealing the complex shapes of roots and their canals [10,11]. **Figures 1 and 2.**

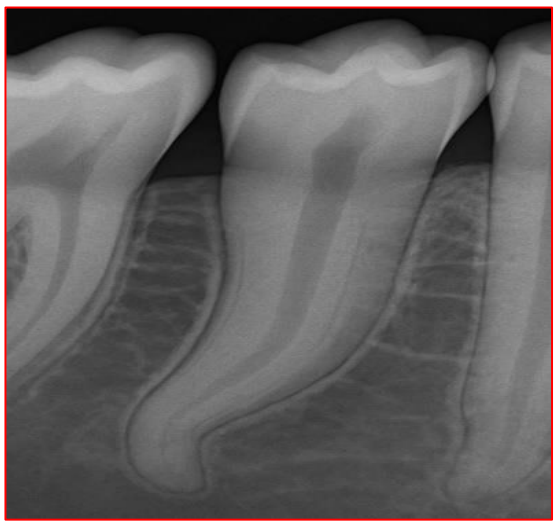

Figure 1: Periapical image showing a mandibular premolar with dilacerated root.

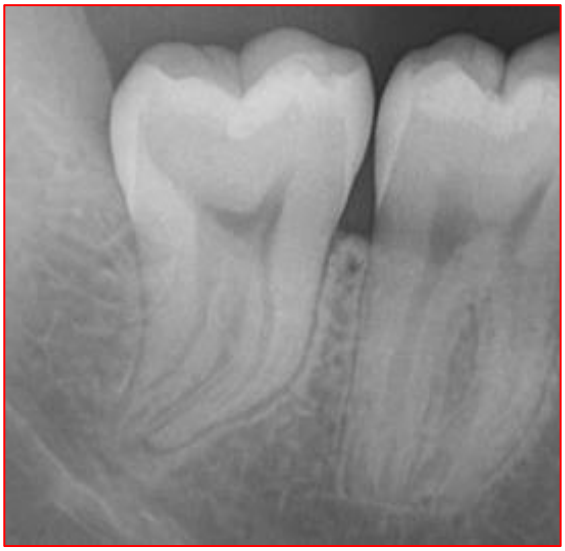

Figure 2: Periapical image showing a mandibular third molar with dilacerated root.

The causes behind dilaceration remain not fully clear and spark quite a bit of debate across different studies. Mechanical trauma affecting the predecessor of a deciduous tooth often comes up as the most common factor linked to root dilaceration, which in turn leads to dilaceration in the developing permanent tooth [12-14]. However, as pointed out before, some research argues trauma might not be the key cause when it comes to dilacerations in posterior teeth. This is partly because evidence shows that dilacerations due to traumatic injuries in permanent teeth happen less often compared to trauma in deciduous teeth, affecting roughly 11–30% of individuals [15,16]. Therefore, several etiological factors, especially for posterior teeth, should be taken into consideration as causes. In addition, dilacerations could be caused by gender, racial or mechanical conditions that interfere with tooth development (such as tumors, cysts, or supernumerary teeth) [17–20] On the other side, the high occurrence of dilaceration in third molar teeth may be due to limited space and ectopic development of tooth [8].

In situations lacking obvious signs of trauma, unexplained developmental defects appear as a common cause behind root dilacerations. These occur more often compared to crown dilacerations, particularly in first premolar teeth. On the other hand, crown dilacerations tend to be reported more frequently in the maxillary and mandibular central incisors, usually linked to injuries affecting deciduous teeth [21].

Many studies have reported that dilacerations are the most common developmental defect in different populations, either in males or females [22–24]. Other studies reported that dilaceration can also be related to several developmental disorders or abnormalities, including Axenfeld-Rieger syndrome, Ehlers-Danlos syndrome (hypermobility type), congenital ichthyosis and Smith-Magenis syndrome. Hereditary factors, extraction of primary teeth, scar formation, mechanical interference with tumor, cyst, eruption (odontogenic hamartoma), tooth transplantation, developmental deformity of the deciduous tooth germ, facial cleft, advanced root canal infections, effect of some anatomic structures (as in maxillary sinus, mandibular canal and nasal fossa), ectopic tooth development and lack of space are other potential contributing factors that have been reported [4,7, 25, 26]

Materials and Methods

This study took a look at a range of published research found in academic databases—"PubMed, Scopus, Web of Science, Google Scholar"—covering dental abnormalities, especially root dilacerations in teeth, across adult patients aged 18 to 65, male and female alike. Research came from multiple countries and stretched over the years 2002 through 2024. Focus stayed on figuring out how common root dilacerations were during that span. The included studies relied on various diagnostic images, captured at differing angles, to identify and assess the dilaceration cases. **Table 1.**

Table 1: Distribution of root dilacerations of teeth in different studies.

	Hamasha AA, Al-Khateeb T, Darwazeh A 2002 [5]	Malčić A Et al, 2006 [8]	Ali Sami 2008 [27]	Udoye CI, and Jafarzadeh H 2009 [28]	Miloglu O et al 2010 [29]	Nabavizadeh MR 2013 [30]	Bodrumlu E, 2013 [31]	Ameera KK et al 2022 [32]	Asheghi B et al 2024 [33]
Patient/Teeth/ Radiographs (n) / Tooth type	4655 teeth	953 periapical and 488 panoramic images	1908 teeth	706 teeth and 256 films	2,124 patients/ 6386 teeth	250 patients	9,406 teeth/ 5,504 patients	750 subjects	927 premolar teeth and 132 CBCT
Mandibular 1st molars	5.6	2.2	6.87			0.6	4.9		
Mandibular 2nd molars		1.7	9.83			1.6	5.2		
Mandibular 3rd molar	19.2	24.1	20.58		12.8		10.7		
Mandibular 1st premolars			5.77				2.2		31.6
Mandibular 2nd premolars			4.51				2.7	1.6	26
Mandibular canines							1.3		
Mandibular lateral incisors			0.9						
Mandibular incisors	1						0.1		
Maxillary 1st molars		15.3	7.48		6.7	1.3	5.8		
Maxillary 2nd molars		11.4	13.8				4.9		
Maxillary 3rd molars		8.1	7.4				5.0		
Maxillary 1st premolars							2.4		22.8
Maxillary 2nd premolars			6.36				2.9		19.6
Maxillary canines	1						1.8		
Maxillary lateral incisors			4				4.6		
Maxillary incisors	1						0.7		

Results

The review's statistical results placed root dilaceration prevalence at 4.85% overall. Interestingly, variation appeared across tooth types, even within that same total rate. Certain teeth showed a greater tendency. Posterior permanent teeth, especially, stood out. Mandibular third molars reached the highest rate, 1.22%. Then came mandibular first premolars (0.63%). Next, maxillary first molars (0.58%), and then mandibular second premolars, at 0.55%. Following that: maxillary second molars (0.48%) and maxillary second premolars (0.46%). Not far behind, maxillary first premolars, recorded at 0.40%. Maxillary third molars showed 0.32%. Then mandibular first molars (0.31%), and finally, mandibular second molars, lowest among them, at 0.27%.

On the other hand, the data seemed to lean toward a much lower prevalence in the anterior region, less than 0.3% of total cases, which stood out. The maxillary lateral incisor showed the highest figure among anterior teeth (0.14%), while the maxillary canine followed (0.04%). Then came the maxillary central incisor (0.03%). Lower down, the mandibular canines and central incisors both stood at 0.02%, and the mandibular lateral incisor came in last (0.01%). As for overall distribution, there was a clear difference between jaws—mandible accounted for 61.8%, maxilla for 38.2%. **Table 2.**

Table 2. Frequency of Root Dilacerations according to tooth type.

Tooth Type	Prevalence (%)	
Posterior Teeth		
Mandibular third molars	1.22%	High prevalence
Mandibular first premolars	0.63%	
Maxillary first molars	0.58%	
Mandibular second premolars	0.55%	
Maxillary second molars	0.48%	Moderate prevalence
Maxillary second premolars	0.46%	
Maxillary first premolars	0.40%	
Maxillary third molars	0.33%	
Mandibular first molars	0.31%	
Mandibular second molars	0.27%	
Anterior Teeth		
Maxillary lateral incisors	0.14%	Low prevalence
Maxillary canines	0.04%	
Maxillary central incisors	0.03%	
Mandibular canines	0.02%	
Mandibular central incisors	0.02%	
Mandibular lateral incisors	0.01%	

Discussion

Root dilaceration, a dental root irregularity marked by a sudden curve or bend, tends to arise from early trauma, genetic disposition, or spatial limitations during eruption. Prevalence shifts noticeably across different groups. Radiographic images remain the standard for identifying such anomalies, especially since they often complicate procedures like extractions, endodontic therapy, or orthodontic adjustment. Severity guides the clinical response; milder cases might only require adjusted endodontic access, while more severe instances may lead to surgical extraction if restoration proves unfeasible. Detection at an early stage makes a difference, reducing risks and guiding more effective, case-specific planning.

Dental anomalies—looked into across many cultures, many ethnic groups too—but still, results vary. Could be the way samples are picked, or maybe how "diagnosis" gets defined; hard to line it all up. Dilaceration, now that's one of the trickier ones—where a tooth root or crown bends, curves, or just doesn't grow straight [34]. It can get in the way, big time. Makes pulling teeth harder than it should be, messes with root canals, slows down braces—more than just a minor issue [4,8,7].

The current study looked through a range of earlier research focused on root dilaceration in teeth, concluding that the overall occurrence rate sits at about 4.85%. Among the teeth studied, mandibular third molars appeared with the highest rate, 1.22%, while mandibular first premolars followed at 0.63%, and then maxillary first molars at 0.58%. Other posterior teeth, across both jaws, showed a gradual drop in prevalence yet remained within notable margins: mandibular second premolars at 0.55%, tapering off to 0.27% in mandibular second molars.

Some studies show root dilaceration rates lower than this review's results. For example, Hamasha and Darwazeh (2002) reported it at 3.78% [5]. Then, Nabavizadeh et al. (2013) found it even less common, only 0.3% in their examined teeth [30]. Amal (2017) noted dilaceration made up 2.9% of dental anomalies [35]. Also, Udoye CI and Jafarzadeh H (2009) found a similar number, 2.9%, of total teeth with dilaceration [32]. A few other studies list dilaceration as the least common anomaly, too [36,37]. But, on the other hand, some research shows higher rates than this review, with incidence reaching 9.5% [29].

Mandibular third molar teeth, it turns out, are the ones most often showing dilacerations—Hamasha and Darwazeh (2002) reported a figure of 19.2%. Following those, mandibular first molars came next at 5.6% [5]. Then there's Miloglu et al (2010), who also found mandibular third molars leading to root dilacerations with 12.8%. Right after, maxillary third molars showed 7.4%, and maxillary first molars, 6.7% [29]. Another perspective comes from Ana Malčić (2006), who noted the highest incidence again in mandibular third molars, this time 24.1%. Then, maxillary first molars appeared at 15.3%, maxillary second molars at 11.4%, and maxillary third molars at 8.1% [8].

Nabavizadeh et al. (2013) found something a bit different. The mandibular second molar came out on top, with 1.6% dilaceration. Just behind that, the maxillary first molar showed 1.3%, and the mandibular first molar had 0.6% [30]. Then, Ali Sami's data showed the maxillary second molar making up 13.08% of root dilacerations. Next in line were maxillary first molars at 7.48%, second premolars at 6.36%, and lateral incisors at 4%. On the mandibular side, third molars led again, 20.58%, followed by second molars at 9.83%, and first molars at 6.87%. Also, premolars seemed to share a similar story across jaws: about 4.51% in mandibular second premolars and 5.77% in maxillary first premolars, according to Ali's study [27].

The review at hand revealed that root dilacerations in anterior teeth occur very rarely, together making up under 0.3% of cases overall. Among anterior teeth, the maxillary lateral incisor, frequently noted to emerge with the highest involvement rate, recorded at approximately 0.14%. In contrast, other teeth in the same group show markedly lower occurrences. Maxillary canines are observed in approximately 0.04% of instances. Just beneath that range, the occurrence of maxillary central incisors holds at approximately 0.03%. Mandibular central incisors and canines, on the other hand, generally stay near 0.02%, exhibiting a consistency that, while unremarkable at first glance, suggests a degree of developmental stability. At the lowest frequency, the mandibular lateral incisor is seen in close to 0.01% of instances.

These seemingly narrow margins, subtle as they may be, point toward anatomical particularities or nuanced growth patterns. Not necessarily dramatic, yet possibly significant enough to warrant further consideration.

Hamasha and Darwazeh (2002) observed that the mandibular incisors and maxillary anterior teeth showed the lowest frequency of dilaceration among teeth [5]. In contrast, Miloglu et al. (2010) reported no instances of root dilaceration in maxillary central incisor teeth, as well as mandibular central and lateral incisor teeth during their study [27].

The review's findings also showed root dilaceration cases aren't evenly spread between the jaws. About 61.8% happen in the mandible, while 38.2% show up in the maxilla. So, nearly two-thirds affect the lower jaw; just over a third involve the upper. The mandible's rate is roughly 1.6 times that of the maxilla, quite a bit higher. This points toward some anatomical or developmental reason that favors lower teeth, especially toward the back. That jaw-specific pattern means clinical checks should focus more on mandibular molar and premolar teeth in particular. But maxillary cases still matter since they make up over a third. The strong mandibular dominance gives useful insight, not just for diagnosis but also for digging into what causes this dental oddity.

Hamasha and Darwazeh (2002) also found that two-thirds of the dilaceration cases were in the mandible [5]. On the other side, Malčić A et al. (2006), also found that dilacerations in the mandibular jaw were less frequent than in the maxillary jaw [8]. Some studies found that the tooth root dilacerations were similarly distributed between the mandible and maxilla. [29,30].

Anatomical and developmental things tied to the mandible, such as bone density, how teeth come in, or just limited space, seem to play a role in why root dilaceration happens more there. Clinically, this means that mandibular back teeth need close attention during X-rays and treatment plans. Front teeth, on the other hand, usually don't cause as much worry with this issue. The big gap in how often it shows up between upper and lower jaws makes it clear that location-specific risks must be kept in mind, both when diagnosing and doing research.

Conclusion

Root dilacerations showed up in about 4.85% overall, but the numbers shift depending on which tooth is in question. Posterior teeth seem to take the brunt of it. Mandibular third molars came out on top at 1.22%, then the mandibular first premolars at 0.63%, with maxillary first molars close behind at 0.58%. Other posterior teeth saw a decrease in prevalence but still stayed within a noticeable range, somewhere around 0.27 to 0.55%. Anterior teeth, meanwhile, barely showed up, under 0.3% total, with maxillary lateral incisors a bit more involved at roughly 0.14%. Another thing that caught attention was the strong mandibular predominance: 61.8% compared to 38.2% in the maxilla, pointing to clear anatomical trends. These points emphasize why clinicians need to keep tooth-specific differences in mind. It hints that development or biomechanical factors might be shaping how roots form, especially in those posterior teeth of the lower jaw. Altogether, the findings bring valuable epidemiological perspectives for dental diagnosis and treatment planning.

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Conflicts of interest

No conflict of interest in the study

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