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Review Article

Fiber Posts in Restorative Dentistry: A Narrative Review of Clinical and Laboratory Evidence

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ABSTRACT

This research aimed to synthesize and evaluate current scientific findings concerning both clinical outcomes and laboratory investigations on fiber-reinforced posts, emphasizing the cementation procedures used in restorative dentistry. A systematic search of the PubMed/Medline database was conducted for publications from 2010 to 2023. The search combined the terms "fiber post," "intra-coronal post," "post cementation," and "post length." Articles were first screened by title and abstract; those meeting inclusion standards were fully reviewed. References from included studies were also checked to identify additional relevant works. Out of 135 initial publications, 90 met the inclusion requirements based on their abstracts, and 50 were retained after full-text evaluation. Further relevant papers from citations were incorporated, resulting in 57 studies in total. Data from both in vitro and clinical research suggest that fiber posts exhibit a similar survival rate to prefabricated or cast metal posts, with most failures attributed to loss of retention. Posts shorter than two-thirds of the root length performed well when a ferrule effect was present, which also increased the lifespan of restored teeth. Additionally, surface conditioning of fiber posts and adhesive bonding techniques contributed to improved clinical durability and long-term success of post-retained restorations.

Keywords: Nonvital tooth, Fiber-reinforced post, Luting agents, Post length

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Introduction

Teeth that have undergone endodontic therapy are structurally compromised and therefore more prone to biomechanical fracture, often necessitating prosthetic reconstruction [1]. The decision to insert a post primarily depends on the quality and quantity of residual tooth structure. Prior studies have highlighted that both the presence of a ferrule (±2 mm) [2–5] and the number of remaining coronal walls [5–11] are key determinants of the tooth's ability to endure functional loading, regardless of post material or restoration design.

Laboratory research has demonstrated that increasing the number of remaining coronal walls significantly enhances fracture resistance [6, 7]. Tooth position is another factor: anterior teeth, exposed to lateral stress, fail more frequently than posterior teeth, which mainly experience vertical loading [4, 12–14].

Growing patient expectations for aesthetic restorations, especially in the anterior region, have accelerated the adoption of nonmetallic post systems such as fiber posts. These posts consist of a resin-based matrix, usually derived from epoxy resins [15], giving them an elastic modulus close to dentin (≈30 GPa vs. 18 GPa) and far below that of metal posts (≈108.6 GPa) [16]. This similarity allows stress absorption and transmission to occur more evenly through the root, lowering the probability of irreparable fractures [16].

Although fiber posts permit some light diffusion along the canal, the light intensity and bond strength typically diminish from the cervical region toward the apical third [17]. Bonding in the root canal remains complex because of restricted access, limited visibility, and fewer dentinal tubules in the apical area, along with secondary dentin formation, which can cause adhesive failure over time [18].

Proper selection of post material is therefore critical, as its physical and mechanical attributes dictate how stress is dispersed within the tooth. Numerous systems are available, including cast metal, prefabricated metal, and the more recent translucent fiber posts [15]. Similarly, a broad range of luting materials, each with unique formulations and clinical protocols, has been introduced [19].

Accordingly, this review compiles recent laboratory and clinical findings to provide an updated, evidence-based summary that can guide clinicians in selecting the most suitable post system and cementation method for restorative treatment.

Materials and Methods

Eligibility criteria

Only studies meeting the following standards were included:

They had to be peer-reviewed, written in English, and published between 2010 and 2023 **(Table 1)**.

Table 1. Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Articles written in **English**	Publications dated **prior to 2010**
Research investigating **fiber post intra-canal length**, **cementation methods**, or **survival performance**	**Finite element studies** lacking **in vitro confirmation**; **meta-analyses**, **systematic** or **literature reviews**
Prospective, **retrospective clinical**, and **in vitro experimental studies**	**In vitro investigations** performed on **bovine**, **primary**, or **immature teeth**
—	**In vitro research** employing **artificial roots** created from **composite resin blocks**

Data sources

An electronic literature review was executed using PubMed, integrating the search expressions “fiber post,” “intra-coronal post,” “post cementation,” and “post length.” The review covered retrospective and prospective clinical trials as well as in vitro investigations. Additionally, the reference sections of the selected articles were examined to identify other relevant publications not captured in the main database search.

Search strategy

After removing repeated entries, a total of 135 abstracts from potential studies were examined, leading to the inclusion of 90 articles centered on the intra-canal length of fiber posts, cementation techniques, and their survival outcomes. Exclusion parameters included studies based solely on finite element analysis without experimental verification, in vitro tests on bovine, deciduous, or immature teeth, as well as those utilizing artificial root replicas made of composite blocks. For clinical trials, when several publications from the same research presented various observation periods, the one with the longest follow-up was selected. After comprehensive assessment of the complete manuscripts, 51 articles met the inclusion criteria. Furthermore, the reference lists of these papers were reviewed, adding 6 more relevant studies, resulting in a total of 57 included works **(Figure 1)**.

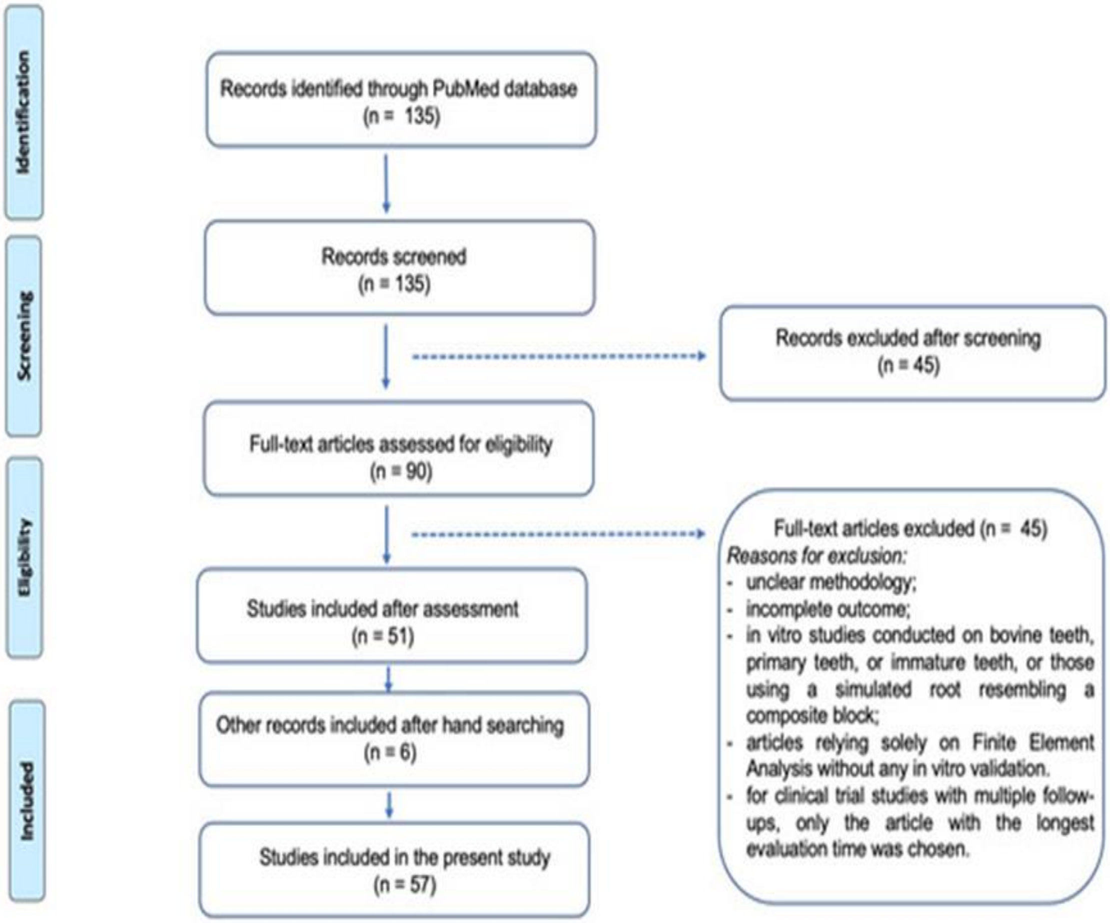

Figure 1. PRISMA flow diagram illustrating the screening and selection stages.

Data included

Extracted information from each selected study—such as authorship, publication year, post type, luting material, and tooth position—is presented in **Table 2**. Papers lacking any of these data points were omitted. Details about material mechanical behavior, the effect of residual dental tissue on outcomes, and survival rates, including reasons for failure in both clinical and in vitro research, were examined and analyzed in this investigation.

Table 2. Results derived from in vitro evaluations.

Authors and Year	Post Types	Length	Mechanical Properties (Fracture Resistance, N)	Luting Agent	Teeth Localization
Amarnath *et al*., 2015 [1]	Stainless steel (Parapost, Coltene Whaledent)	4 mm	122 N (7.11 N)	Paracore dual cure resin cement, Coltene Whaledent, Cuyahoga Falls, OH, USA	Lower premolars
		7 mm	246 N (6.81 N)		
		10 mm	188.5 N (5.74 N)		
	Glass fiber (Parapost Fiber-lux, Coltene Whaledent)	4 mm	68.5 N (7.11 N)		
		7 mm	137.5 N (6.81 N)		
		10 mm	140.5 (5.74)		
Mobilio *et al*., 2013 [2]	Glass fiber post (GFP; Size #2 RelyX Fiber Post, 3M ESPE AG, Espepl, Seefeld, Germany)	5 mm	1736.4 (1113.8)	Self-adhesive resin cement (RelyX Unicem Aplicap, 3M ESPE, Espepl, Seefeld, Germany)	Lower premolars

		7 mm	1038.6 (600.2)		
Zicari *et al.*, 2013 [5]	Without fiber post/RelyX Posts (3M-ESPE, Espepl, Seefeld, Germany)	10 mm	Without ferrule: 361.5 (151.7)/577.0 (104.9) With ferrule: 392.51 (76.30)/388.00 (71.97) 758.5 (121.9)/647.6 (132.9)	Panavia F 2.0 (Kuraray, Tokyo, Japan)	Upper premolars
Hou, Gao and Sun, 2013 [6]	Without fiber post	8 mm	Coronal walls 0: 850 (120) 1: 1020 (170) 2: 1680 (220) 3: 1940 (450) 4: 1980 (300)	Self-etch; Bisco Inc., Schaumburg, IL, USA	Single-rooted lower premolars
	Quartz fiber posts (D.T. Light-Post; Bisco Inc., Schaumburg, IL, USA)		0: 1410 (360) 1: 1580 (180) 2: 2070 (390) 3: 2160 (370) 4: 2210 (430)		
Mangold and Kern, 2011 [7]	Glass fiber posts (Komet ER DentinPost; ISO size 90, Brasseler), airborne-particle abraded for 5 s at 30 mm with 50 µm alumina particles (Heraeus Kulzer) at 0.25 MPa	7.5 mm	0: 537.6 (55.1) 1: 672.3 (7.5) 2: 756.8 (126.8) 3: 1065.9 (211.8)	Panavia 21 TC; Kuraray Medical Inc., Tokyo, Japan	Lower premolars
	Without fiber post		0: 335.6 (39.7) 1: 497.2 (93.5) 2: 702.4 (95.9) 3: 885.3 (208.8)		
Valdivia *et al.*, 2012 [8]	Intact teeth	10 mm	844.8 (186.5)	Self-adhesive resin cement (RelyX Unicem 2; 3M ESPE)	Upper central incisors
	Class III with prefabricated glass fiber post (Exacto Translucido No. 3; Angelus Science and Technology, Londrina, PR, Brazil)		894.1 (397.4)		
Torres-Sánchez *et al.*, 2013 [9]	Glass fiber posts (Tenax; Coltène/Whaledent, Altstätten, Switzerland)/Type IV gold alloy (Argendent 90; The Argen Corp, San Diego, CA, USA)	10 mm	127.91 (14.02)/79.92 (5.66) 48.21 (4.61)/38.04 (3.89) 39.04 (3.78)/55.40 (5.88)	RelyX Luting; 3M ESPE, St. Paul, MN, USA RelyX ARC; 3M ESPE Multilink System Pack; Ivoclar Vivadent, Schaan, Liechtenstein	Single-rooted premolars
Ramírez-Sebastià *et al.*, 2014 [11]	FRC Postec Plus (Ivoclar Vivadent, Schaan, Liechtenstein)	10 mm	432.6 (55.3)	Clearfil DC Bond, Kuraray, Japan	Upper central incisors
		5 mm	470.9 (55.2)		
Castro *et al.*, 2012 [13]	Exacto (Angelus, Londrina, PR, Brazil)—glass fiber post: cleaned with	2/3rd	655.6 (145.8)/2940.5 (917.3)/2217.8 (691.1)/2854.2 (642.9)	RelyX-U100 (3M ESPE, Seefeld, Germany)	Upper incisors/upper canines/uppe

	70% alcohol and silane agent applied (Angelus, Londrina, PR, Brazil)				r two-rooted premolars/lower first molars (with ferrule)
	Kromalit (Knebel, Porto Alegre, RS, Brazil)—Ni–Cr alloy post and core: sandblasted with 50 µm aluminum oxide particles under 2 bars pressure for 10 s and cleaned in distilled water		711.3 (154.7)/3278.6 (702.5)/2161.4 (602.2)/2934.0 (785.9)		
Remo *et al.*, 2010 [15]	Quartz fiber posts (Endo Light post) Glass fiber posts (White Post DC #2, FGM, Joinville, SC, Brazil)	5 mm	41.68 (5.31)	Dual cured resin cement (Prime&Bond NT + Fluorocore 2)	Single-rooted premolars
		7 mm	44.88 (6.77)		
		9 mm	510 (199.8)		
Barcellos *et al.*, 2013 [16]	Fiberglass posts (Angelus, Londrina, PR, Brazil) covered with resin composite Z250 (B0.5, Z250, 3M ESPE)	9 mm	260.23 (69.74)	Rely X ARC (3M ESPE)	Upper canine teeth
	Nickel–chrome alloy (Ni–Cr alloy, Kromalit; Knebel, Porto Alegre, RS, Brazil)		241.35 (68.27)		
Thakur and Ramarao, 2019 [20]	Custom-made glass fiber (Angelus Rua Goias, Londrina, PR, Brazil)	1/2th/2/3 rd	159.97 (34.06)/166.84 (33.11)	Luxa core Z-dual-cure (DMG, Hamburg, Germany)	Lower first premolars (without ferrule)
	Prefabricated glass fiber (Reforpost, Angelus, Londrina, PR, Brazil)		224.2 (32.9)/250.33 (15.40)		
	Prefabricated carbon fiber (Reforpost, Angelus, Londrina, PR, Brazil)		204.07 (29.63)/201.39 (41.44)		
	Ribbond (Ribbond Inc., Seattle, WA, USA)—polyethylene fiber post		146.44 (13.53)/179.75 (33.52)		
Li *et al.*, 2011 [21]	D.T. Light FRC post (Bisco Inc., Schaumburg, IL, USA)	10 mm	305.73 (76.34)	Conventional glass ionomer cement (Fuji, GC Corp., Tokyo, Japan)	Upper central incisors (without ferrule)

	Macro-Lock FRC post (RTD Inc., Saint-Egrève, France)		449.50 (113.18)	ParmaCem (DMG Inc., Hamburg, Germany)	
	Ni–Cr alloy cast post (Bego, Bremen, Germany)		511.09 (91.95)		
Gopal *et al.*, 2017 [22]	EasyPostTM (Dentsply Maillefer) Whitepost DC (FGM)—glass fiber: abraded by airborne particles for 5 s using 50 µm alumina particles at 0.1 MPa	10 mm	657.80 (57.37) 762.40 (251.49) 258.3 (12.7)	Calibra Esthetic (Dentsply Maillefer)—etch and rinse PermaFlo DC (Ultradent Pord. Inc., South Jordan, UT, USA)—self-etch SmartCem (Dentsply Maillefer)—self-adhesive	Upper central incisors (without ferrule)
Habibzadeh *et al.*, 2017 [23]	Ni–Cr alloy (Wiron 99, Bego, Bremen, Germany)	2/3rd	780.59 (270.53)	Panavia F2.0 (Kuraray, Noritake, Dental Inc., Tokyo, Japan)	Premolars (with ferrule)
	Zirconia post and core using MAD-MAM (Zirkonzahn, Gais, Italy)		435.34 (220.41)		
	Light post (Illusion X-RO, RTD, Saint Egreve, France)—glass fiber		915.71 (323.60)		
Solomon and Osman, 2011 [24]	Luscent Anchors (Dentatus, NY, USA)—glass fiber post	8 mm	678.84 (199.45)	Parapost cement (Coltene Whaledent, West Sussex, UK)	Upper incisor (with ferrule)
	Parapost fiber White (Coltene, Whaledent, Mahwah, NJ, USA)—carbon fiber post		653.01 (208.86)		
	Surtex Classic Posts (Dentatus, NY, USA)—titanium post		682.82 (208.86)		
	Custom cast dowel and core (nickel–chromium alloy)		1673.41 (490.74)		
Chuang *et al.*, 2010 [25]	Carbon fiber post (J. Morita, Osaka, Japan)	10 mm/5 mm	1248.81 (117.60)/1253.76 (79.68)	Bistite II DC (Tokuyama Dental Corp., Tokyo, Japan)	Upper anterior teeth (with ferrule)
	Glass fiber post (J. Morita, Osaka, Japan)		1292.33 (185.86)/1247.17 (53.03)		
	Stainless steel post (J. Morita, Osaka, Japan)		973.27 (115.42)/1338.79 (121.84)		
Maroulakos, Nagy, and Kontogiorgos,	Parapost XH (Coltene/Whaledent)—titanium alloy	11 mm	123.5 (23.4)	Panavia 21 (Kuraray Noritake Dental Inc., Tokyo, Japan)	Anterior upper teeth (without ferrule)

2015 [26]					
	D.T. Light-Post (Bisco Inc.)—quartz fibers		117.6 (19.3)		
	Ney-Oro 60 (Dentsply Intl)—gold alloy		174.0 (51.0)		
Ok *et al.*, 2014 [27]	Cast post core	2/3rd	1949.35 (316.0)	Bifix, QM, (Voco GmbH, Cuxhaven, Germany)	Upper canine teeth
	Glass fiber post (Uicore Ultradent, Salt Lake City, UT, USA)		1722.48 (144)/1486.19 (191.7)	Rebilda (Voco, Cuxhaven, Germany) Bifix, QM, (Voco GmbH, Cuxhaven, Germany)	
Franco *et al.*, 2014 [28]	Fibrekor (Jeneric/Pentron)—fiber glass post: cleaned with 70% ethanol and water, and silanized (Cleafil SE Bond Primer, Kuraray, Co., Ltd., Kuraray Medical Inc., Tokyo, Japan)	10 mm/7.5 mm/5 mm	236.08 (19.68)/212.17 (17.12)/200.01 (28.07)	Panavia 21 (Kuraray, Osaka, Japan)	Upper canines (without ferrule)
	Type IV gold alloy (Stabilor G; Degussa Dental AG)—cast post and core (control)	10 mm	634.94 (53.2)		
Doshi *et al.*, 2019 [29]	Glass fiber posts (Coltene Whaledent, OH, USA)	10 mm	343.89 (10.44)	Rely X Ultimate adhesive universal resin cement (3M ESPE, St. Paul, MN, USA)	Upper central incisors
	everStick Post (GC, Europe) foil		452.32 (14.35)		
	Carbon fiber posts (Angelus, Londrina, Brazil)		281.26 (10.81)		
	Without fiber post		576.52 (20.39)		
Jindal *et al.*, 2012 [30]	Ribbond (Ribbond Inc. Seattle, WA, USA)—polyethylene fiber post	10 mm/5 mm	216.930 (53.40)/299.62 (53.42)	Monocem (Shofu dental)	Upper central incisors (with ferrule)
	Glass fiber post (Fibrapost No.2, Produits Dentaires S.A., Vevey, Switzerland)		740.21 (29.87)/425.18 (42.73)		
Kivanç, Alaçam, and Görgül, 2010 [31]	everStick Post (Stick Tech Ltd., Turku, Finland)—custom-made glass FRC post	10 mm	936.58 (299.83)	Panavia F (Kuraray)	Single-rooted upper premolars
	Filpost (Filhol Dental, Baltimore,		891.50 (243.17)		

	MD, USA)—titanium post				
	Polyethylene woven fiber post (Ribbond Inc., Seattle, WA, USA)		827.25 (275.52)		
	Without post		920.33 (162.24)		
Rippe *et al.*, 2014 [32]	Ni–Cr alloy (Wironia Light, Bego, Bremen, Germany)	10 mm	707.5 (125.6)	Self-adhesive resin cement (RelyX U100, 3M ESPE, St. Paul, MN, USA)	Single-rooted teeth
	Glass fiber posts (White Post DC #2, FGM, Joinville, SC, Brazil)		510 (199.8)		
Mastrogianni *et al.*, 2021 [33]	Glass fiber posts (FRC Postec Plus, Ivoclar Vivadent)	9 mm	1422.85 (344.11)	Panavia F 2.0, Kuraray, Tokyo, Japan	Lower premolars
	Prefabricated metal posts (Stainless steel, Parapost, Coltene)		2427.17 (497.96)		
	Without post		224.36 (196.25)		
Palepwad and Kulkarni, 2020 [34]	Cast metal post	6 mm	269.02 (88.22)	Dual-polymerizing resin cement (LuxaCore Z)	Central incisors
		8 mm	299.15 (92.13)		
	Glass fiber post (Hi-Rem post)	6 mm	143.03 (49.17)		
		8 mm	178.18 (56)		
	Zirconia post (ER Cera post)	6 mm	216.91 (66.43)		
		8 mm	299.70 (113.95)		
Zicari *et al.*, 2012 [35]	RelyX Posts (3M-ESPE, Seefeld, Germany) Without fiber post	10 mm	392.51 (76.30)/388.00 (71.97)	Panavia F 2.0 (Kuraray, Tokyo, Japan)/RelyX Unicem (3M ESPE, Seefeld, Germany)	Upper premolars
		7.5 mm	404.81 (149.77)/443.96 (166.23)		
		5 mm	440.52 (222.31)/499.20 (189.76)		
Samran *et al.*, 2018 [36]	Whitepost DC (FGM)—glass fiber (Angelus, Londrina, PR, Brazil)	10 mm	258.3 (12.7) 218.7 (11.1) 165.4 (8.9)	RelyX Ultimate Clicker (3M ESPE, St. Paul, MN, USA)—etch and rinse Breez (Pentron, Orange, CA, USA)—self-adhesive Ketac Cem (3M ESPE, St. Paul, MN, USA)	Lower first premolars (with ferrule)
Bond Strength (MPa)					
Reis *et al.*, 2011 [19]	Glass fiber posts (Fibrekor, Jeneric Pentron Incorporated,	9 mm	7.66 (2.67) 7.16 (4.29) 2.80 (1.04)	Self-cured resin cement C&B Cement (Bisco, Schaumburg, IL, USA)	Single-rooted teeth

	Wallingford, CT, USA)			Glass ionomer cement Ketac Cem (3M ESPE, St. Paul, MN, USA) Resin-modified glass ionomer cement GC FujiCEM (GC Corp., Tokyo, Japan)	
Farina *et al.*, 2011 [37]	Fiberglass posts (Angelus, Londrina, PR, Brazil)	2/3rd	8.11 (2.30)/3.28 (0.82)	RelyX-Unicem (3M ESPE, Seefeld, Germany)/Cement-post (Angelus, Londrina, PR, Brazil)	Upper canines (without ferrule)
	Carbon fiber posts (Angelus, Londrina, PR, Brazil)		5.13 (1.34)/2.27 (0.074)		
da Silva *et al.*, 2015 [38]	Exacto post (Angelus, Londrina, Brazil)	10 mm	14.32 (2.84)/11.56 (4.13)	Breeze self-adhesive (Pentron Clinical Tec, Wallingford)/Panavia F 2.0 (Kuraray, Osaka, Japan)	Single-rooted teeth (without ferrule)
	everStick Post (StickTeck Ltd., Turku, Finland)		16.89 (2.66)/13.69 (3.26)		
Yaman *et al.*, 2014 [39]	Glass fiber (radix; Dentsply Maillefer)	10 mm	13.9 (3.8)/9.9 (2.9)	Panavia F 2.0 (Kuraray, Osaka, Japan)/RelyX Unicem (3M ESPE)	Single-rooted premolars
	Zirconia post (B&L Biotech Co., Fairfax, VA, USA)		7.2 (2.1)/11.5 (4.0)		
Başaran *et al.*, 2019 [40]	Snow post (Carbotech, Ganges, France)—zirconia glass fiber	10 mm	9.3 (2.3.80)	Duo-link (Bisco, Schaumburg, IL)	Upper central incisors (with ferrule)
	Ribbond (Ribbond Inc., Seattle, WA, USA)—polyethylene fiber		8.24 (1.89)		
	D.T. light-post (Bisco, Schaumburg, IL)—quartz glass fiber		8.87 (3.08)		
	Cytec blanco (Hahnenkratt, Konigsbach-Stein, Germany)—glass fiber		9.2 (2.78)		
Pereira *et al.*, 2013 [41]	Reforpost N.2 (Angelus, Londrina, PR, Brazil)	10 mm	19.1 (7.4) 9.6 (7.2) 16.4 (3.4) 14.0 (3.6)	CG Gold label (GC Corp., Tokyo, Japan) Rely X ARC (3M ESPE, Paul, MN, USA) BisCem (Bisco, Schaumburg, IL, USA) RelyX U100 (3M ESPE, Paul, MN, USA)	Upper canines (without ferrule)
Onay, Korkmaz , and Kiremitc i, 2010 [42]	Whitepost DC (Whitepost DC 1; FGM)—glass fiber	10 mm	15.41 (1.54) 12.6 (1.9) 16.13 (1.94) 10.7 (1.68)	All Bond SE/Duo-Link (Bisco, Inc., Schaumburg, IL, USA) All Bond 3/Duo Link (Bisco, Inc., Schaumburg, IL, USA) BisCem (Bisco, Inc., Schaumburg, IL, USA)	Incisors (without ferrule)

				Clearfil ED primer II/Clearfil Esthetic Cement (Kuraray)	
Özcan *et al*., 2013 [43]	Snowpost (Kuraray, Tokyo, Japan)	10 mm	22.4 (2.46) 19.8 (2.46) 18.1 (2.45) 23.8 (2.5)	RelyX Unicem (3M ESPE) Panavia F 2.0 (Kuraray, Osaka, Japan) Maxcem (Kerr, West Collins Orange, CA, USA) Clearfill SA (Kuraray, Osaka, Japan)	Lower premolars (with ferrule)
Bitter *et al*., 2012 [44]	RelyX Fiber Post size 2 (3M ESPE)	8 mm	13.2 (9.5) 13.2 (10.6) 18.3 (10.3)	Panavia F 2.0 (Kuraray, Osaka, Japan) Variolink II (Ivoclar Vivadent, Schaan, Liechtenstein) RelyX Unicem (3M ESPE, Seefeld, Germany)	Upper central (without ferrule)
Leme *et al*., 2011 [45]	DC White Post (FGM)—glass fiber post	10 mm	3.81 (1.07) 4.26 (2.29)	RelyX ARC (3M ESPE, Paul, MN, USA) RelyX Unicem (3M ESPE)	Single-rooted teeth (without ferrule)
Jongsma *et al*., 2010 [46]	D.T Light-Post (RTD, St. Egreve, France)	12 mm	4.8 (1.9) 5.4 (3.2) 4.9 (3.4)	Clearfil DC Core (Kuraray)—etch and rinse RelyX Unicem (3M ESPE)—self-adhesive Panavia F 2.0 (Kuraray)—self-etching	Canines (without ferrule)
Albashaireh *et al*., 2010 [47]	Fiber glass post (EasyPost; Dentsply Maillefer) with no treatment/Acidic treatment (36% phosphoric acid for 15 s)/Airborne-particle-abrasion treatment (50 mm alumina particles—Heraeus Kulzer GmbH at 2.5-bar pressure, 36.3 psi for 5 s)	10 mm	272.2 (64.6)/284.8 (67.1)/342.8 (70.3)	Calibra (Dentsply DeTrey)	Upper anterior and premolar teeth

Results and Discussion

Characteristics of fiber posts

Prefabricated post-and-core restorations offer numerous benefits, notably a straightforward and efficient clinical approach [20]. In particular, nonmetallic prefabricated posts show excellent fracture strength because of their adhesive capability with the tooth structure and improved stress absorption and distribution when compared with metallic posts [21]. This phenomenon has been referred to as a short-term reinforcement effect, also known as the endodontic "Monoblock" [22].

Multiple laboratory investigations have assessed posts with distinct elastic moduli, including zirconia [23], carbon fiber [24, 25], stainless steel [25], prefabricated titanium [26], glass fiber, and cast posts [13, 16, 23–28]. These studies demonstrated that posts with higher elastic modulus transfer stress to the root apex, often causing root fractures, whereas those with dentin-like elasticity distribute occlusal forces more uniformly, decreasing fracture likelihood.

Nevertheless, one of the most frequent complications for teeth restored with fiber posts is debonding of the post/core complex [4, 26–29], which typically leads to reparable fractures. Concerning their mechanical properties **(Table 1)**, reported findings vary. Several in vitro investigations found that glass fiber posts exhibit greater fracture strength [20, 23, 30] and higher adhesion to tooth tissues [31] than other types, while some reported comparable results between fiber posts and both prefabricated and cast metallic posts [13, 25, 31, 38–40]. Others, however, observed reduced bond strength and fracture resistance for glass fiber posts relative to metal ones [21, 24, 26–28, 32–34]. Notably, the maximum bite force of posterior teeth is estimated to range from 420 ± 112 N to 632 ± 174 N [48], aligning with the fracture limits of many fiber post systems currently available.

Fiber post length

Traditionally, it has been recommended that the intra-canal post length equal approximately two-thirds of the remaining tooth structure, or at minimum match the crown height, and not be shorter than half of the alveolar bone level encircling the root, ensuring adequate retention and minimizing catastrophic root fractures [1]. The most suitable post dimension should correspond to the dowel space while preserving as much tooth tissue as possible [6, 7, 13]. Additionally, factors such as root and crown dimensions, bone support, and ferrule presence must be considered when positioning an intra-canal post [15].

Due to their favorable stress distribution and repairable fracture pattern, many in vitro analyses [11, 15, 25, 28, 34, 35] recommend fiber posts with shorter intra-canal extensions (approximately one-third of the root length ≥ 6 mm). Research by Thakur A and Ramarao S [20] demonstrated that posts cemented slightly above half of the root (around 8 mm) exhibited mechanical performance comparable to those cemented at two-thirds of the root length.

Although shorter posts offer benefits such as conserving dentin, lowering root perforation risk [25, 35], and allowing easier retreatment, they may compromise intra-canal retention [1]. Conversely, increasing post length does not necessarily enhance retention for fiber posts luted with resin-based agents, as numerous studies [38, 40–43] have shown diminished bonding quality in the apical third, mainly due to anatomical and procedural constraints. Furthermore, some works [2, 15, 34] found no statistically significant differences between tested post lengths, suggesting that unless the intra-canal portion is shorter than one-third of the root, post length has minimal effect on fracture resistance—provided that an appropriate cementation method is used [2].

Cementation

Resin-based cements are widely favored for post placement because they provide reliable retention and substantial resistance to fracture [35]. Several anatomical and histological aspects of the root canal can influence the adhesive performance of luting agents, leading to noticeable variations in bonding effectiveness across different regions of dentin within the same tooth [42]. Concerning bonding approaches, while the etch-and-rinse method has long been the standard for use with resin cements [10, 14, 49, 50], developments in adhesive chemistry have introduced easier systems such as self-etch and self-adhesive cements, which streamline the procedure and reduce clinical time. Self-adhesive cements also remove the need for applying and rinsing phosphoric acid in the apical area, resulting in a less technique-sensitive and more predictable bonding process [37, 51].

Despite extensive investigation into post-cementation materials and methods, laboratory outcomes have often been inconsistent. Some reports indicate that self-adhesive luting cements exhibit markedly higher bond strength values **(Table 1)** [37–39, 41–45, 51, 52], whereas others describe similar performance among various adhesive systems [22, 46]. This positive behavior of self-adhesive resin cements may be attributed to their chemical composition, which provides higher tolerance to moisture compared to self-etching varieties [38, 42]. However, certain studies have observed weaker bond strength and reduced fracture resistance with self-adhesive agents than with etch-and-rinse or self-etch cements [36]. Such discrepancies may be related to variations in tooth morphology, differences in preparation techniques, or surface pretreatments—all of which may significantly influence the cementation results [46].

Moreover, the longevity of the post retention is largely determined by the bonding mechanism formed between the luting agent and the dental substrate [9, 41, 51]. The chemical composition of the cement can also affect water absorption and subsequent hygroscopic expansion, which in turn may impact long-term stability [19, 41].

Surface treatment of fiber posts

A variety of conditioning techniques for fiber post surfaces have been investigated. Common methods include etching with phosphoric acid (36% for 15 s), applying a silane coupling agent [37], and/or coating with an adhesive resin layer [47]. Silanization is generally considered beneficial for enhancing post retention within the root canal, depending on the material composition of the post [37, 46]. Long-term follow-ups on silane application for titanium [4] and fiber posts demonstrated no debonding after approximately 8.8 years [50] and 11 years [4], respectively. In addition, surface roughening through airborne-particle abrasion has been shown to improve micromechanical interlocking by increasing surface area and surface energy, thereby enhancing retention [47, 53]. Some reports have also discussed the concept of customizing glass fiber posts. Excessively thick cement layers may result in uneven stress distribution at the post–cement–dentin interface, potentially compromising retention [35].

Survival from longitudinal studies

Given the ever-changing environment of the oral cavity, evidence from long-term clinical follow-up provides the most credible insights. Multiple investigations have shown promising outcomes for fiber post restorations [3, 4, 49], with survival rates extending beyond a decade. Comparative studies assessing prefabricated metal versus fiber posts [54–56] have reported similar long-term success rates for both materials.

A randomized long-term clinical investigation [4] assessed glass fiber and titanium posts (Fiberpoints Root Pins Titanium) luted with a self-adhesive cement (RelyX Unicem; 3M ESPE). Each specimen incorporated a 2 mm ferrule and a 9 mm post length. The canal and coronal surfaces were cleaned using air abrasion, followed by irrigation with 2 mL of 99.6% ethanol and drying with paper points. Titanium posts underwent tribochemical silica coating (2.8 bar, 13 s, Rocatec Soft, 3M ESPE), after which a silane layer (ESPE-SIL; 3M ESPE) was applied and air-dried for both post types. Results indicated a significant reduction in survival rates after the fifth year, dropping from 86.4% to 58.7% for glass fiber posts and from 92.5% to 74.2% for titanium posts between the 5- and 8-year observations. The most frequent failure patterns included horizontal root fractures and endodontic complications associated with apical periodontitis.

A clinical evaluation by Naumann *et al*. (2012) [49] examined two fiber post systems: one parallel-sided with a serrated texture (FibreKor, Jeneric Pentron) and another with a tapered design (Luscent Anchors, Dentatus), in 1.0, 1.25, and 1.5 mm sizes. Posts were bonded using an etch-and-rinse system (EBS-Multi, 3M ESPE, Germany) and monitored for 10 years. Each post was cleaned with alcohol, air-dried, and coated with a thin bonding layer. Although the failure rate in anterior teeth was observed to be roughly twice that of premolars and molars, no significant performance differences were detected between the two post types. Other studies also confirmed higher failure tendencies in anterior teeth [3, 49, 54], though some reports noted the opposite trend—greater failures in posterior teeth [14]. This discrepancy might stem from the limited sample size (72 teeth) and short 3-year assessment, as posterior teeth primarily endure vertical forces, whereas anterior teeth experience lateral stress, placing them at higher risk of structural failure [4, 12–14].

In another randomized clinical trial [10], researchers compared a prefabricated glass fiber post (DT Light Post) to a custom-made glass fiber post (everStick Post). Both were cemented with resin cements (Calibra and BisCore) to restore single-crown premolars. After 6 years, the overall survival rate reached 94.1%, favoring prefabricated posts for greater reliability. Teeth with more remaining coronal structure showed higher success rates.

A separate randomized trial [14] evaluated the longevity of glass fiber posts (White Post DC, FGM) versus cast metal CoCr posts in teeth lacking coronal walls. Posts occupied two-thirds of the canal and supported single crowns. Post-space was prepared using #5 Gates Glidden burs (Dentsply Maillefer). Fiber posts were treated with ethanol and silane (ProSil, FGM) before being cemented with RelyX ARC and RelyX U100 (3M ESPE). After 3 years, survival rates were 97.1% (n = 35) for fiber and 91.9% (n = 37) for metal posts, with no significant differences between materials or cements. Anterior teeth (97.5%) again demonstrated higher survival than posterior teeth (90%).

Another randomized study [54] assessed three systems: a prefabricated glass post (Parapost FibreLux, Coltène-Whaledent), a custom-made post (everStick, StickTech—GC America), and a gold cast post and core (Parapost, Coltene-Whaledent; Medior 3 Cendres + Métaux), all cemented using Panavia F 2.0/ED Primer II (Kuraray). After 5 years, the overall survival was 91.4% for prefabricated fiber posts, 92.1% for custom-made ones, and 91.2% for the gold cast system. The most frequent complication was post dislodgement, occurring in 30.9% of anterior and 18.02% of posterior teeth, mainly among custom-made fiber posts. Similarly, a prior investigation [57] of quartz translucent fiber posts (DT Light SL9; VDW GhB, Munich) over 2 years found excellent outcomes, with no periapical pathology, using self-etching Calibra cement (Dentsply, Kostanz, Germany) and silane pretreatment.

A long-term retrospective study [50] compared outcomes in endodontically treated teeth with and without posts over 8.8 years using Easy Post and Easy Post Lux (Dentsply). Post-spaces were created with Largo Peeso burs and precision drills, and posts were placed in teeth with one wall or less than one-third remaining crown height. Each 8 mm post was alcohol-cleaned, silanized (Monobond S/Plus; Ivoclar Vivadent, Schaan, Liechtenstein), and bonded using an etch-and-rinse resin cement. Teeth restored with fiber posts achieved 94.3% survival, far exceeding 76.3% for teeth without posts, regardless of restoration type. No post debonding was seen. The study concluded that in teeth with limited structure, fiber posts substantially reduced tooth loss, and that the use of crowns did not significantly enhance prognosis compared to uncrowned restorations.

Final remarks / considerations

The limitations of this review lie in the small number of long-term clinical trials and the absence of standardized treatment guidelines. Therefore, additional long-term research with clearer clinical parameters is needed. The review primarily targeted recent publications (2010 onward) indexed in PubMed, which may have restricted the pool of evidence. However, its main goal was to summarize the most current understanding of fiber post systems and bonding approaches over the past 13 years.

Conclusion

Across the analyzed studies, fiber, prefabricated, and cast metal posts exhibited comparable survival rates between 3–10 years. The lower elastic modulus of fiber posts correlated with favorable mechanical behavior. Post/core debonding was the predominant cause of failure. Surface pretreatments like silane application were shown to improve adhesion, while both conventional and self-adhesive cements offered similar long-term outcomes.

Additionally, the presence of a ferrule was deemed critical for post–restoration durability. Under this condition, fiber posts shorter than two-thirds of the root canal length still provided satisfactory results. Future investigations should explore optimized canal cleaning, gutta-percha removal, and fiber post retrieval protocols, which remain under-researched.

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