Table 1. Databases, search strings, and documents found for the initial stage of database review

Database	Initial search equation	# Docs
Scopus	(TITLE-ABS-KEY ("endodontic file") AND TITLE-ABS-KEY(fatigue))	208
Dimensions.ai	"endodontic file" AND "fatigue"	183
WOS	TEMA: ("endodontic file") AND TEMA: (fatigue)	25
Science Direct	"endodontic file" AND "fatigue"	19

Source: by authors

Table 2 Summary of the fatigue failure on endodontic file research studies

Study findings	Analyzed Variable(s)	Authors	Year
E: Cyclic axial motion significantly extends fatigue life.	Fracture Time	Dederich et al. [18]	1986
C: Life cycle depends on the radius of curvature	Fracture Time	Haïkel et al. [19]	1999
E: Analyze the type of defects after clinical use	Fracture type	Sattapan et al. [20]	2000
C: Cutting edge design does not affect fatigue life, but the file size does.	Fracture Time	Chaves-Craveiro et al. [21]	2002
I: Fatigue is the failure mechanism of Hedstrom files.	Cracks	Zinelis et al. [22]	2002
E: The shape of root canals affects the life of the file.	Flexibility	Kuhn et al. [23]	2002
E: Curved canals adversely affects torsional strength for Profile files.	Angular speed and Torque	Azevedo-Bahía et al. [24]	2006
E: Evaluate the influence of curvature on fatigue life	Arc length	Pereira-Lopes et al. [25]	2007
E: Heat treatment temperature influences fatigue strength	Temperature and rotations	Zinelis et al. [6]	2007
E: Exposure to sodium hypochlorite does not affect fracture toughness.	Torque, angle and NCF	Ormiga et al. [26]	2007
E: As angular deformation increases, fatigue cycles decrease.	Torque, angle and NCF	Ormiga et al. [27]	2007
C: Material alloys ratio affects the fatigue life	Angle of twist	Johnson et al. [28]	2008
E: Electropolishing does not affect the fatigue life of the files.	Torque, angle and NCF	Ormiga et al. [29]	2008
E: Fracture patterns obtained by SEM can explain the fracture process.	Torque, angle and NCF	Ormiga et al. [7]	2008
C: Files manufactured by twisting showed increased fatigue strength.	Fracture Time	Gambarini et al. [30]	2008
L: Normative is required to standardize fatigue testing	None	Plotino et al. [11]	2009
E: Fatigue is the main cause of file fracture over a static torsion	Fracture type and rate	Inan et al. [8]	2009
E: Argon implantation improves performance of S1 files moderately.	Number of cycles and crack	Brilhante-Wolle et al. [31]	2009
C: The process of manufacturing affects the fatigue strength of the file	Angle of twist	Park et al. [32]	2010
E: Standard operation does not affect the self-adjusting file.	Fracture Time	Hof et al. [33]	2010
C: M-wire exhibits higher fatigue strength than SE-Wire files	Number of cycles	Gao et al. [34]	2010
C: Fracture is related to austenitic size grain	Size and type of alloy grain	Pirani et al. [9]	2011
C: Twisting files show higher strength. Ductile fracture is observed.	Fracture type and NCF	Rodrigues et al. [35]	2011
C: Reciprocating motion and twisting manufacturing improve strength.	Fracture time	Castelló-Escrivá et al. [36]	2012
C: TF files have a higher fatigue resistance than GTX files.	Number of cycles	Miglio et al. [37]	2012
S: Constitutive relationship for flexural fatigue	Bending stresses	Leroy et al. [38]	2012
C: Manufacturing affects the fatigue life	Number of cycles	Bhagabati et al. [39]	2012
E: Preflaring helps to increase fatigue life	Number of cycles	Ehrhardt et al. [40]	2012
E: Geometry of canal affects fatigue life and fracture size	Fracture length	Al-Sudani et al. [41]	2012
C: Manufacturing affects the fatigue life	Number of cycles	Bouska et al. [42]	2012
C: NiTi files have better mechanical fatigue behavior than steel	Strength failure	Pereira-Lopes et al. [43]	2012

C: Compare brands to find the one with higher fatigue life	Number of cycles	Capar et al. [44]	2013
C: Fracture length is an invariant	Fracture length	Plotino et al. [45]	2014
E: Reciprocate motion affects the fatigue life	Angular speed and torque	Testarelli et al. [46]	2014
E: Immersion in different irrigation solutions affects the fatigue life	Time of immersion	Pedullá et al. [47]	2014
C: 15% torsional preload reduces the fatigue strength of EDM files	Preload, torque, and angle	Campbell et al. [48]	2014
C: Mwire and CM treatments increase fatigue resistance of rotary files.	Fracture time	Braga et al. [49]	2014
C: Compare brands to find the one with higher fatigue life	Number of cycles	Sousaa et al. [50]	2015
C: Compare brands to find the one with higher fatigue life	Number of cycles	Capar et al. [51]	2015
E: Preloads of torsion and fatigue are inversely proportional	Number of cycles	Shen et al. [52]	2015
C: Preloads reduce the fatigue strength of files	Preload, torque and angle	Pedullá et al. [53]	2015
E: Austenitic phase shows long fatigue life but reduced in R phase	NCF, % elongation	Freitas et al. [54]	2015
C: Compare brands to find the one with higher fatigue life	Number of cycles	Özyürek et al. [55]	2016
S: Stress intensity factors allow understanding the fatigue failure	Stress intensity factor	Isidoro et al. [56]	2016
C: Compare brands to find the one with higher fatigue life	Number of cycles	Uslu et al. [57]	2016
E: Large strains affect the fatigue life	Number of cycles	Chih-Wen et al. [58]	2016
C: Compare new and used files to find the one with higher fatigue life	Number of cycles	Taha et al. [55]	2016
E: Martensitic grain decreases the fatigue life	Size and type of alloy grain	Carvalho et al. [1]	2016
E: The depth of the machining groove affects the NCF	Fracture time	Lopes et al. [59]	2016
C: EDM, CMwire support lower torque but higher angle than Mwire	Torque and angle	Lo Savio et al. [60]	2016
E: Back-forward motion extends fatigue life	Fracture time	Loios et al. [61]	2016
C: Cyclic bending load reduces the torsional strength of CM files	Torque and NCF	Peláez-Acosta et al. [62]	2016
E: The temperature of the environment influences the NCF	Water temperature, NCF	Dosanjh et al. [63]	2017
C: Low environment temperature increases fatigue resistance	Temperature, NCF	Grande et al. [64]	2017
E: Ti-Zr-B coating can improve fatigue resistance	Fracture time	Chih-Wen et al. [65]	2017
E: Reduced apical depth generates less stress on the file	Screw-in force	Jung-Hong et al. [66]	2017
E: Heat treatment increases fatigue resistance and cutting efficiency.	Fracture time	Chih-Wen et al. [67]	2017
C: Compare brands to find the one with higher fatigue life	Number of cycles	Gundogar et al. [68]	2017
C: Compare brands to find the one with higher fatigue life	Number of cycles	Azim et al. [69]	2018
E: Relationship between the kinematics of file motor and fatigue life	Number of cycles	Iacono et al. [70]	2018
E: Torsional preloads reduce fatigue strength of EDM files	Preload, torque and angle	Shen et al. [71]	2018
E: Hypochlorite concentrations and temperature influence resistance	Number of cycles	Alfawaz et al. [72]	2018
E: Fatigue life is affected by torque and curvature of the canal	Torque and curvature	Bhatta et al. [73]	2019
C: Compare brands to find the one with higher fatigue life	Number of cycles	Jamleh et al. [74]	2019
E: Microtomography allows non-destructive analysis of files	Number of cycles	Bastos et al. [75]	2019

C: Compare new and used files to find the one with higher fatigue life	Number of cycles	Alvez et al. [3]	2020
E: 2D-3D representations of canals show differences in stresses	Number of cycles	Piasecki et al. [76]	2020
C: S-One files with higher resistance than M-Two, used in natural canals.	Fracture time	Miccoli et al. [77]	2020
C: Fatigue resistance decreases at body temperature	Fracture time	Generali et al. [78]	2020
C: All files are efficient in the preparation of the canal.	Fracture time	Drukteinis et al. [79]	2020
C: ReFlex Smart file reciprocating motion increases fatigue resistance	Fracture time	Zubizarreta et al. [80]	2021
C: Gold and Blue treatment improves resistance (bending and fatigue)	Fracture time and load	Xiao-Mei et al. [81]	2021
E: Increasing apical and taper diameter reduces the dynamic fatigue strength	Fracture time and pecks	Faus-Llácer et al. [82]	2021

C: Comparison between brands; E: Experimental study on particular factors; L: Literature review; S: Simulations; I: Inspection

Source: by authors