Oral Hygiene

- **Reasons for Wearing Retainers After Treatment**
  Reasons for Wearing Retainers After Treatment Differences Between Removable and Fixed Retention Establishing a Routine to Prevent Tooth Shifting Oral Hygiene Tips for Retainer Care Monitoring Changes After Active Orthodontic Phase Factors That Influence Retention Duration Communicating the Value of Long Term Follow Ups How Retainers Support Jaw Positioning Over Time Signs That Signal the Need for Retainer Adjustments Materials Used in Crafting Effective Retainers Incorporating Retainer Wear Into Daily Habits Assessing Compliance and Its Impact on Stability
- **Basics of Brushing With Braces or Aligners**
  Basics of Brushing With Braces or Aligners Practical Tips for Flossing Around Orthodontic Wires Understanding the Role of Mouthwash in Oral Care Techniques to Prevent White Spots on Enamel Avoiding Common Foods That Damage Orthodontic Appliances Solutions for Managing Gum Irritation and Inflammation Tools That Simplify Cleaning With Orthodontic Hardware Importance of Regular Dental Checkups During Treatment Risk Factors for Plaque Buildup With Braces Adapting Hygiene Routines for Clear Aligner Users Balancing Oral Care With Busy Lifestyles Early Intervention for Minor Issues That Escalate
- **About Us**

Okay, so your retainer should feel, well, like a part of you. Not in a creepy, permanent-fixture way, but in a comfortable, almost unnoticeable way. If that feeling starts to fade, and you're suddenly thinking, "Man, this thing feels weird," that's your first red flag. Maybe it's started pinching a little, or rubbing uncomfortably against your gums. Perhaps it just doesn't sit quite right anymore, like it's a size too big or too small. Any change, really, from that baseline comfort you're used to is worth paying attention to. Don't just grit your teeth and bear it, hoping it'll go away. A retainer that doesn't fit right isn't doing its job properly, and it could even be causing new problems. Orthodontic treatments can improve speech and chewing functions **Pediatric orthodontic care** crossbite. A quick chat with your orthodontist can nip these little issues in the bud and get you back to that comfortable, secure fit you need to keep your smile straight and happy. Don't underestimate the power of a well-fitting retainer - it's the silent guardian of your hard-earned smile!

* Preventing teeth from shifting back to their original positions as the jawbone settles. —

- *** Maintaining the corrected tooth alignment achieved during braces.**
- *** Preventing teeth from shifting back to their original positions as the jawbone settles.**
- *** Protecting the investment made in orthodontic treatment.**
- *** Ensuring the long-term stability of the bite and smile.**
- *** Supporting proper jaw growth and development in younger children.**
- *** Avoiding the need for future, potentially more extensive, orthodontic intervention.**
- *** Contributing to overall oral health by preventing crowding and misalignment.**

Okay, so you're rocking your retainer like a champ, keeping that smile straight and beautiful. But things happen, right? Life throws curveballs, and sometimes those curveballs involve your trusty retainer. One of the most obvious signs that it's time to call your orthodontist for an adjustment is visible damage. I mean, we're talking cracks, warps, or even outright breaks. If you see something that just doesn't look right, like a piece is missing or it's bent out of shape, don't ignore it. A damaged retainer isn't going to do its job properly, and you risk your teeth shifting back towards their old positions. Plus, a crack can become a breeding ground for bacteria, and nobody wants that. So, be a good friend to your smile and if you notice any visible damage, get that retainer checked out ASAP. A quick fix now is way easier than dealing with a bigger problem later on.

* Protecting the investment made in orthodontic treatment.

Okay, so your retainer's in, but something just feels...off. You're trying to ignore it, hoping it'll magically resolve itself, but deep down, you know something might be amiss. Let's talk about one of those sneaky signs that your retainer needs a little TLC: speech difficulties or excessive salivation.

Think about it. Your mouth is a finely tuned instrument. Your tongue, cheeks, and teeth work together to form words clearly. Your saliva glands produce just the right amount of moisture for comfortable swallowing. Now, throw a retainer into the mix. When it fits perfectly, you barely notice it. But if it's out of whack, even slightly, it can disrupt this delicate balance.

Suddenly, you might find yourself slurring words you normally pronounce without a second thought. Maybe certain sounds are just plain difficult to make. It's like having a tiny obstacle course in your mouth that your tongue has to navigate around every time you speak.

And then there's the saliva situation. An ill-fitting retainer can trigger your saliva glands into overdrive. Your mouth might feel like a veritable waterfall, making you self-conscious about swallowing constantly or even, dare I say, drooling a little. Not exactly the most glamorous look, right?

The reason for this can be multifaceted. The retainer might be pressing on a salivary gland, stimulating it unnecessarily. Or perhaps the altered shape of your mouth, due to the improper fit, is simply confusing your brain into thinking it needs more saliva.

Whatever the cause, don't dismiss these symptoms. Your retainer shouldn't be making you sound like you've had one too many or causing you to constantly reach for a tissue. These are your mouth's way of sending out an SOS. It's time to reach out to your orthodontist for an adjustment. Ignoring it could lead to more significant problems down the line, and nobody wants that. A quick adjustment now can save you a lot of stress (and potentially a lot of drool) later.

* Ensuring the long-term stability of the bite and smile.

Okay, so your retainer's starting to feel like a medieval torture device? Not good. Pain or pressure when you pop that thing in, or even while you're just wearing it, is a definite red flag. It's not supposed to hurt. A little snugness is normal, especially after not wearing it for a while, but outright pain or persistent pressure? That's your retainer screaming for help, or rather, screaming for an adjustment. Think of it like this: your teeth are used to being in a certain position, and your retainer is supposed to gently encourage them to stay there. If it's putting too much force on specific teeth, that's a sign something's shifted, either with your teeth themselves or with the retainer's fit. Ignoring the pain won't make it go away; it could actually make things worse, potentially shifting your teeth in unwanted directions. So, listen to your mouth! Pain and pressure are your body's way of saying, “Hey, something's off here.” Time to give your orthodontist a call.

* Supporting proper jaw growth and development in younger children.

Okay, so you've diligently worn your retainer (mostly, anyway!), and you're feeling pretty good about your straight smile. But wait a minute... are those little gaps between your teeth starting to creep back again? It's subtle, maybe just a tiny space you swear wasn't there before, but it's enough to make you pause. Gaps reappearing between your teeth are definitely a sign that something might be amiss and that your retainer could need an adjustment.

Think of your retainer as a diligent little security guard, constantly reminding your teeth to stay in their assigned positions. When gaps start to show up, it's like the security guard is slacking off a bit. Your teeth, being the mischievous little things they are, are starting to stray from the straight and narrow. This could be because the retainer isn't fitting quite as snugly as it used to, maybe it's warped slightly, or perhaps your teeth are experiencing some minor shifts that the retainer simply isn't strong enough to counteract anymore.

Ignoring these reappearing gaps is like ignoring that leaky faucet – it might seem insignificant at first, but it can lead to bigger problems down the road. The longer you wait, the more your teeth might drift, and the more complex (and potentially costly) the correction could become. So, if you're noticing even the smallest gaps popping up, don't hesitate to give your orthodontist a call. A quick adjustment to your retainer could be all it takes to keep your smile perfectly aligned and avoid more extensive treatment later on. It's always better to be proactive when it comes to maintaining that hard-earned straight smile!

*** Avoiding the need for future, potentially more extensive, orthodontic intervention.**

Okay, so your retainer's giving you a hard time, huh? Like, a real struggle? You're yanking and pulling to get it in, or maybe it feels like it's stuck in cement when you try to take it out? That difficulty inserting or removing your retainer is a definite sign something's not quite right and likely means you need to get it adjusted.

Think about it this way: your retainer is designed to fit snugly, but not forcefully. It should glide into place with a gentle push, and pop out without requiring Herculean strength. If you're needing to wrestle with it every time, something has shifted. Maybe your teeth have moved slightly, or perhaps the retainer itself has warped a little due to heat, cleaning methods, or just general wear and tear.

Ignoring this difficulty isn't going to make it magically disappear. In fact, forcing it in or out can actually damage the retainer, or worse, put undue pressure on your teeth, potentially undoing some of the progress you made with braces or aligners in the first place! It's like trying to jam the wrong puzzle piece into place: you might force it, but you'll probably break something in the process.

So, instead of battling your retainer and risking further problems, listen to what your mouth is telling you. Schedule an appointment with your orthodontist. They can assess the situation, make the necessary adjustments, and get your retainer fitting comfortably again. Remember, a retainer that fits properly protects your smile, and a little adjustment now can save you from bigger headaches (and dental bills) down the road.

* Contributing to overall oral health by preventing crowding

and misalignment.

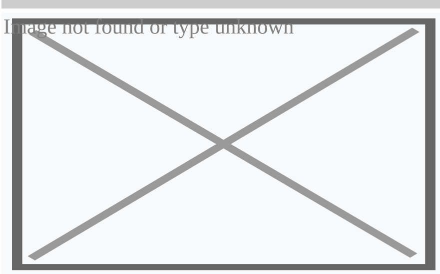
Okay, so your retainer's making a racket? We're talking pops, clicks, maybe even a little snap-crackle-pop symphony happening in your mouth every time you put it in or take it out. That's not exactly the sweet sound of retainer success, is it? More likely, it's a sign that something's not quite right and your retainer needs a little TLC, courtesy of your orthodontist.

Think of it this way: a well-fitting retainer should slide in relatively easily and sit snugly. No drama, no acrobatics, just a comfortable, secure fit. But when it starts popping or clicking, it usually means it's not seating properly. Maybe it's warped slightly, or your teeth have shifted a tiny bit (it happens!). That popping sound? It's the retainer being forced into a position it doesn't naturally want to be in, like trying to shove a square peg into a slightly-off-kilter round hole.

Ignoring it isn't the answer. That constant pressure and movement could actually cause more shifting and potentially damage your retainer. It's kind of like ignoring a squeaky wheel – it's only going to get louder and more problematic over time. So, if you're hearing those telltale pops and clicks, give your orthodontist a call. A quick adjustment might be all you need to get back to that comfortable, secure, and silent retainer experience. After all, you want your retainer to keep your smile straight, not become a tiny, orthodontic percussion instrument.

About crossbite

Crossbite



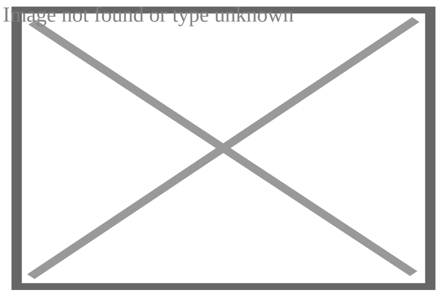
Unilateral posterior crossbite

Specialty	Orthodontics

In dentistry, **crossbite** is a form of malocclusion where a tooth (or teeth) has a more buccal or lingual position (that is, the tooth is either closer to the cheek or to the tongue) than its corresponding antagonist tooth in the upper or lower dental arch. In other words, crossbite is a lateral misalignment of the dental arches.[1][2]

Anterior crossbite

[edit]



Class 1 with anterior crossbite

An anterior crossbite can be referred as negative overjet, and is typical of class III skeletal relations (prognathism).

Primary/mixed dentitions

[edit]

An anterior crossbite in a child with baby teeth or mixed dentition may happen due to either dental misalignment or skeletal misalignment. Dental causes may be due to displacement of one or two teeth, where skeletal causes involve either mandibular hyperplasia, maxillary hypoplasia or combination of both.

Dental crossbite

[edit]

An anterior crossbite due to dental component involves displacement of either maxillary central or lateral incisors lingual to their original erupting positions. This may happen due to delayed eruption of the primary teeth leading to permanent teeth moving lingual to their primary predecessors. This will lead to anterior crossbite where upon biting, upper teeth are behind the lower front teeth and may involve few or all frontal incisors. In this type of crossbite, the maxillary and mandibular proportions are normal to each other and to the cranial base. Another reason that may lead to a dental crossbite is crowding in the maxillary arch. Permanent teeth will tend to erupt lingual to the primary teeth in presence of crowding. Side-effects caused by dental crossbite can be increased recession on the buccal of lower incisors and higher chance of inflammation in the same area. Another term for an anterior crossbite due to dental interferences is *Pseudo Class III Crossbite or Malocclusion*.

Single tooth crossbite

[edit]

Single tooth crossbites can occur due to uneruption of a primary teeth in a timely manner which causes permanent tooth to erupt in a different eruption pattern which is lingual to the primary tooth.[3] Single tooth crossbites are often fixed by using a finger-spring based appliances.[4][5] This type of spring can be attached to a removable appliance which is used by patient every day to correct the tooth position.

Skeletal crossbite

[edit]

An anterior crossbite due to skeletal reasons will involve a deficient maxilla and a more hyperplastic or overgrown mandible. People with this type of crossbite will have dental compensation which involves proclined maxillary incisors and retroclined mandibular incisors. A proper diagnosis can be made by having a person bite into their centric relation will show mandibular incisors ahead of the maxillary incisors, which will show the skeletal discrepancy between the two jaws.[6]

Posterior crossbite

[edit]

Bjork defined posterior crossbite as a malocclusion where the buccal cusps of canine, premolar and molar of upper teeth occlude lingually to the buccal cusps of canine, premolar and molar of lower teeth.[7] Posterior crossbite is often correlated to a narrow maxilla and upper dental arch. A posterior crossbite can be unilateral, bilateral, single-tooth or entire segment crossbite. Posterior crossbite has been reported to occur between 7–23% of the population.[8][9] The most common type of posterior crossbite to occur is the unilateral crossbite which occurs in 80% to 97% of the posterior crossbite cases.[10][3] Posterior crossbites also occur most commonly in primary and mixed dentition. This type of crossbite usually presents with a *functional shift of the mandible* *towards the side of the crossbite*. Posterior crossbite can occur due to either skeletal, dental or functional abnormalities. One of the common reasons for development of posterior crossbite is the size difference between maxilla and mandible, where maxilla is smaller than mandible.[11] Posterior crossbite can result due to

- Upper Airway Obstruction where people with "adenoid faces" who have trouble breathing through their nose. They have an open bite malocclusion and present with development of posterior crossbite.[12]
- Prolong digit or suckling habits which can lead to constriction of maxilla posteriorly[13]
- Prolong pacifier use (beyond age 4)[13]

Connections with TMD

[edit]

Unilateral posterior crossbite

[edit]

Unilateral crossbite involves one side of the arch. The most common cause of unilateral crossbite is a narrow maxillary dental arch. This can happen due to habits such as digit sucking, prolonged use of pacifier or upper airway obstruction. Due to the discrepancy between the maxillary and mandibular arch, neuromuscular guidance of the mandible causes mandible to shift towards the side of the crossbite.[14] This is also known as Functional mandibular shift. This shift can become structural if left untreated for a long time during growth, leading to skeletal asymmetries. Unilateral crossbites can present with following features in a child

- Lower midline deviation[15] to the crossbite side
- Class 2 Subdivision relationships
- Temporomandibular disorders [16]

Treatment

[edit]

A child with posterior crossbite should be treated immediately if the child shifts their mandible on closing, which is often seen in a unilateral crossbite as mentioned above. The best age to treat a child with crossbite is in their mixed dentition when their palatal sutures have not fused to each other. Palatal expansion allows more space in an arch to relieve crowding and correct posterior crossbite. The correction can include any type of palatal expanders that will expand the palate which resolves the narrow constriction of the maxilla.[9] There are several therapies that can be used to correct a posterior crossbite: braces, 'Z' spring or cantilever spring, quad helix, removable plates, clear aligner therapy, or a Delaire mask. The correct therapy should be decided by the orthodontist depending on the type and severity of the crossbite.

One of the keys in diagnosing the anterior crossbite due to skeletal vs dental causes is diagnosing a CR-CO shift in a patient. An adolescent presenting with anterior crossbite may be positioning their mandible forward into centric occlusion (CO) due to the dental interferences. Thus finding their occlusion in centric relation (CR) is key in diagnosis. For anterior crossbite, if their CO matches their CR then the patient truly has a skeletal component to their crossbite. If the CR shows a less severe class 3 malocclusion or teeth not in anterior crossbite, this may mean that their anterior crossbite results due to dental interferences.[17]

Goal to treat unilateral crossbites should definitely include removal of occlusal interferences and elimination of the functional shift. Treating posterior crossbites early may help prevent the occurrence of Temporomandibular joint pathology.[18]

Unilateral crossbites can also be diagnosed and treated properly by using a Deprogramming splint. This splint has flat occlusal surface which causes the muscles to deprogram themselves and establish new sensory engrams. When the splint is removed, a proper centric relation bite can be diagnosed from the bite.[19]

Self-correction

[edit]

Literature states that very few crossbites tend to self-correct which often justify the treatment approach of correcting these bites as early as possible.[9] Only 0–9% of crossbites self-correct. Lindner et al. reported that 50% of crossbites were corrected in 76 four-year-old children.[20]

See also

[edit]

- List of palatal expanders
- Palatal expansion
- Malocclusion

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[edit]

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External links

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Classification	○ **ICD-10**: K07.2 D ○ **ICD-9-CM**: 524.27

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Orthodontics

Diagnosis	○ Bolton analysis ○ Cephalometric analysis ○ Cephalometry ○ Dentition analysis ○ Failure of eruption of teeth ○ Little's Irregularity Index ○ Malocclusion ○ Scissor bite ○ Standard anatomical position ○ Tooth ankylosis ○ Tongue thrust
Conditions	○ Overbite ○ Overjet ○ Open bite ○ Crossbite ○ Dental crowding ○ Dental spacing ○ Bimaxillary Protrusion ○ Prognathism ○ Retrognathism ○ Maxillary hypoplasia ○ Condylar hyperplasia ○ Overeruption ○ Mouth breathing ○ Temperomandibular dysfunction

Appliances	◦ ACCO appliance ◦ Archwire ◦ Activator appliance ◦ Braces ◦ Damon system ◦ Elastics ◦ Frankel appliance ◦ Invisalign ◦ Lingual arch ◦ Lip bumper ◦ Herbst Appliance ◦ List of orthodontic functional appliances ◦ List of palatal expanders ◦ Lingual braces ◦ Headgear ◦ Orthodontic technology ◦ Orthodontic spacer ◦ Palatal lift prosthesis ◦ Palatal expander ◦ Quad helix ◦ Retainer ◦ SureSmile ◦ Self-ligating braces ◦ Splint activator ◦ Twin Block Appliance
Procedures	◦ Anchorage (orthodontics) ◦ Cantilever mechanics ◦ Fiberotomy ◦ Interproximal reduction ◦ Intrusion (orthodontics) ◦ Molar distalization ◦ SARPE ◦ Serial extraction
Materials	◦ Beta-titanium ◦ Nickel titanium ◦ Stainless steel ◦ TiMolium ◦ Elgiloy ◦ Ceramic ◦ Composite ◦ Dental elastics

Notable contributors

- Edward Angle
- Spencer Atkinson
- Clifford Ballard
- Raymond Begg
- Hans Peter Bimler
- Samir Bishara
- Arne Björk
- Charles B. Bolton
- Holly Broadbent Sr.
- Allan G. Brodie
- Charles J. Burstone
- Peter Buschang
- Calvin Case
- Harold Chapman (Orthodontist)
- David Di Biase
- Jean Delaire
- Terry Dischinger
- William B. Downs
- John Nutting Farrar
- Rolf Frankel
- Sheldon Friel
- Thomas M. Graber
- Charles A. Hawley
- Reed Holdaway
- John Hooper (Orthodontist)
- Joseph Jarabak
- Harold Kesling
- Albert Ketcham
- Juri Kurol
- Craven Kurz
- Benno Lischer
- James A. McNamara
- Birte Melsen
- Robert Moyers
- Hayes Nance
- Ravindra Nanda
- George Northcroft
- Dean Harold Noyes
- Frederick Bogue Noyes
- Albin Oppenheim
- Herbert A. Pullen
- Earl W. Renfroe
- Robert M. Ricketts
- Alfred Paul Rogers
- Ronald Roth
- Everett Shapiro
- L. F. Andrews
- Frederick Lester Stanton
- Earl Emanuel Shepard

Organizations	○ American Association of Orthodontists ○ American Board of Orthodontics ○ British Orthodontic Society ○ Canadian Association of Orthodontists ○ Indian Orthodontic Society ○ Italian Academy of Orthodontic Technology ○ Society for Orthodontic Dental Technology (Germany)
Journals	○ American Journal of Orthodontics and Dentofacial Orthopedics ○ The Angle Orthodontist ○ Journal of Orthodontics
Institution	○ Angle School of Orthodontia

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Dental disease involving the jaw

General	○ Jaw abnormality ○ malocclusion ○ Orthodontics
Size	○ Gnathitis ○ Micrognathism ○ Maxillary hypoplasia
Maxilla and Mandible	○ Cherubism ○ Congenital epulis ○ Torus mandibularis ○ Torus palatinus

Other	○ Jaw and base of cranium
	    ○ Prognathism
	    ○ Retrognathism
	○ Dental arch
	    ○ Crossbite
	    ○ Overbite
	○ Temporomandibular joint disorder

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About dental braces

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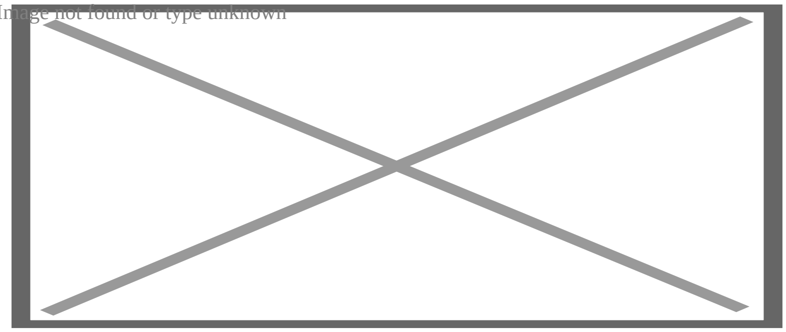

Dental braces

Dental braces (also known as **orthodontic braces**, or simply **braces**) are devices used in orthodontics that align and straighten teeth and help position them with regard to a person's bite, while also aiming to improve dental health. They are often used to correct underbites, as well as malocclusions, overbites, open bites, gaps, deep bites, cross bites, crooked teeth, and various other flaws of the teeth and jaw. Braces can be either cosmetic or structural. Dental braces are often used in conjunction with other orthodontic appliances to help widen the palate or jaws and to otherwise assist in shaping the teeth and jaws.

Process

[edit]

The application of braces moves the teeth as a result of force and pressure on the teeth. Traditionally, four basic elements are used: brackets, bonding material, arch wire, and ligature elastic (also called an "O-ring"). The teeth move when the arch wire puts pressure on the brackets and teeth. Sometimes springs or rubber bands are used to put more force in a specific direction.[1]

Braces apply constant pressure which, over time, moves teeth into the desired positions. The process loosens the tooth after which new bone grows to support the tooth in its new position. This is called bone remodelling. Bone remodelling is a biomechanical process responsible for making bones stronger in response to sustained load-bearing activity and weaker in the absence of carrying a load. Bones are made of cells called osteoclasts and osteoblasts. Two different kinds of bone resorption are possible: direct resorption, which starts from the lining cells of the alveolar bone, and indirect or retrograde resorption, which occurs when the periodontal ligament has been subjected to an excessive amount and duration of compressive stress.[2] Another important factor associated with tooth movement is bone deposition. Bone deposition occurs in the distracted periodontal ligament. Without bone deposition, the tooth will loosen, and voids will occur distal to the direction of tooth movement.[3]

Types

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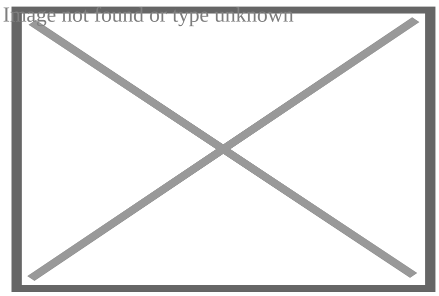
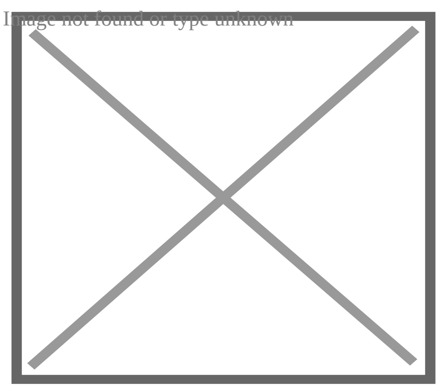


"Clear" braces



Upper and Lower Jaw Functional Expanders

- ***Traditional metal wired*** *braces* (also known as "train track braces") are stainless-steel and are sometimes used in combination with titanium. Traditional metal braces are the most common type of braces.[4] These braces have a metal bracket with elastic ties (also known as rubber bands) holding the wire onto the metal brackets. The second-most common type of braces is self-ligating braces, which have a built-in system to secure the archwire to the brackets and do not require elastic ties. Instead, the wire goes through the bracket. Often with this type of braces, treatment time is reduced, there is less pain on the teeth, and fewer adjustments are required than with traditional braces.
- ***Gold-plated stainless steel*** braces are often employed for patients allergic to nickel (a basic and important component of stainless steel), but may also be chosen for aesthetic reasons.
- ***Lingual*** *braces* are a cosmetic alternative in which custom-made braces are bonded to the back of the teeth making them externally invisible.

- ◦ ***Titanium*** *braces* resemble stainless-steel braces but are lighter and just as strong. People with allergies to nickel in steel often choose titanium braces, but they are more expensive than stainless steel braces.
- ◦ ***Customized orthodontic treatment systems*** combine high technology including 3-D imaging, treatment planning software and a robot to custom bend the wire. Customized systems such as this offer faster treatment times and more efficient results.[5]
- ◦ ***Progressive, clear removable aligners*** may be used to gradually move teeth into their final positions. Aligners are generally not used for complex orthodontic cases, such as when extractions, jaw surgery, or palate expansion are necessary.[*medical citation* [6]

Fitting procedure

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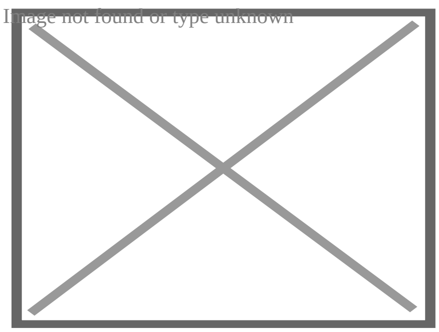


A patient's teeth are prepared for the application of braces.

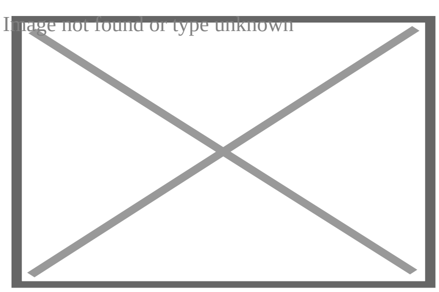
Orthodontic services may be provided by any licensed dentist trained in orthodontics. In North America, most orthodontic treatment is done by orthodontists, who are dentists in the diagnosis and treatment of *malocclusions*—malalignments of the teeth, jaws, or both. A dentist must complete 2–3 years of additional post-doctoral training to earn a specialty certificate in orthodontics. There are many general practitioners who also provide orthodontic services.

The first step is to determine whether braces are suitable for the patient. The doctor consults with the patient and inspects the teeth visually. If braces are appropriate, a records appointment is set up where X-rays, moulds, and impressions are made. These records are analyzed to determine the problems and the proper course of action. The use of digital models is rapidly increasing in the orthodontic industry. Digital treatment starts with the creation of a three-dimensional digital model of the patient's arches. This model is produced by laser-scanning plaster models created using dental impressions. Computer-automated treatment simulation has the ability to automatically separate the gums and teeth from one another and can handle malocclusions well; this software enables clinicians to ensure, in a virtual setting, that the selected treatment will produce the optimal outcome, with minimal user input.[*medical citation needed*]

Typical treatment times vary from six months to two and a half years depending on the complexity and types of problems. Orthognathic surgery may be required in extreme cases. About 2 weeks before the braces are applied, orthodontic spacers may be required to spread apart back teeth in order to create enough space for the bands.

Teeth to be braced will have an adhesive applied to help the cement bond to the surface of the tooth. In most cases, the teeth will be banded and then brackets will be added. A bracket will be applied with dental cement, and then cured with light until hardened. This process usually takes a few seconds per tooth. If required, orthodontic spacers may be inserted between the molars to make room for molar bands to be placed at a later date. Molar bands are required to ensure brackets will stick. Bands are also utilized when dental fillings or other dental works make securing a bracket to a tooth infeasible. Orthodontic tubes (stainless steel tubes that allow wires to pass through them), also known as molar tubes, are directly bonded to molar teeth either by a chemical curing or a light curing adhesive. Usually, molar tubes are directly welded to bands, which is a metal ring that fits onto the molar tooth. Directly bonded molar tubes are associated with a higher failure rate when compared to molar bands cemented with glass ionomer cement. Failure of orthodontic brackets, bonded tubes or bands will increase the overall treatment time for the patient. There is evidence suggesting that there is less enamel decalcification associated with molar bands cemented with glass ionomer cement compared with orthodontic tubes directly cemented to molars using a light cured adhesive. Further evidence is needed to withdraw a more robust conclusion due to limited data.[[7]]

An archwire will be threaded between the brackets and affixed with elastic or metal ligatures. Ligatures are available in a wide variety of colours, and the patient can choose which colour they like. Arch wires are bent, shaped, and tightened frequently to achieve the desired results.



Dental braces, with a transparent power chain, removed after completion of treatment.

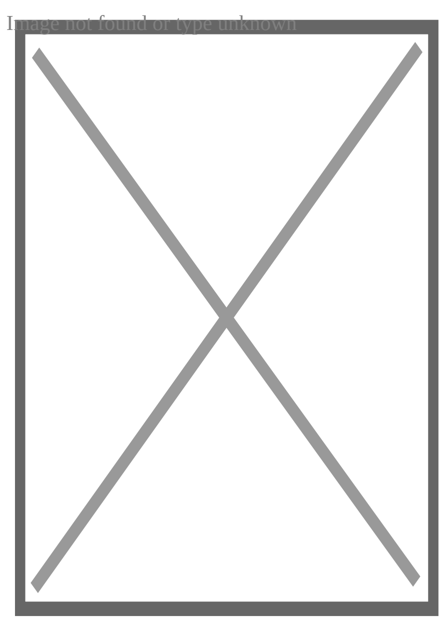
Modern orthodontics makes frequent use of nickel-titanium archwires and temperature-sensitive materials. When cold, the archwire is limp and flexible, easily threaded between brackets of any configuration. Once heated to body temperature, the arch wire will stiffen and seek to retain its shape, creating constant light force on the teeth.

Brackets with hooks can be placed, or hooks can be created and affixed to the arch wire to affix rubber bands. The placement and configuration of the rubber bands will depend on the course of treatment and the individual patient. Rubber bands are made in different diameters, colours, sizes, and strengths. They are also typically available in two versions: Coloured or clear/opaque.

The fitting process can vary between different types of braces, though there are similarities such as the initial steps of moulding the teeth before application. For example, with clear braces, impressions of a patient's teeth are evaluated to create a series of trays, which fit to the patient's mouth almost like a protective mouthpiece. With some forms of braces, the brackets are placed in a special form that is customized to the patient's mouth, drastically reducing the application time.

In many cases, there is insufficient space in the mouth for all the teeth to fit properly. There are two main procedures to make room in these cases. One is extraction: teeth are removed to create more space. The second is expansion, in which the palate or arch is made larger by using a palatal expander. Expanders can be used with both children and adults. Since the bones of adults are already fused, expanding the palate is not possible without surgery to separate them. An expander can be used on an adult without surgery but would be used to expand the dental arch, and not the palate.

Sometimes children and teenage patients, and occasionally adults, are required to wear a headgear appliance as part of the primary treatment phase to keep certain teeth from moving (for more detail on headgear and facemask appliances see Orthodontic headgear). When braces put pressure on one's teeth, the periodontal membrane stretches on one side and is compressed on the other. This movement needs to be done slowly or otherwise, the patient risks losing their teeth. This is why braces are worn as long as they are and adjustments are only made every so often.



Young Colombian man during an adjustment visit for his orthodontics

Braces are typically adjusted every three to six weeks. This helps shift the teeth into the correct position. When they get adjusted, the orthodontist removes the coloured or metal ligatures keeping the arch wire in place. The arch wire is then removed and may be replaced or modified. When the archwire has been placed back into the mouth, the patient may choose a colour for the new elastic ligatures, which are then affixed to the metal brackets. The adjusting process may cause some discomfort to the patient, which is normal.

Post-treatment

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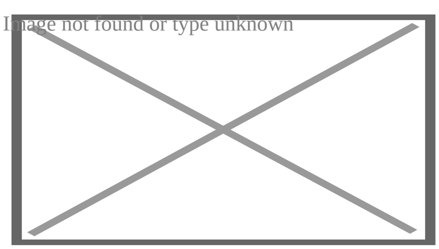
Patients may need post-orthodontic surgery, such as a fiberotomy or alternatively a gum lift, to prepare their teeth for retainer use and improve the gumline contours after the braces come off. After braces treatment, patients can use a transparent plate to keep the teeth in alignment for a certain period of time. After treatment, patients usually use transparent plates for 6 months. In patients with long and difficult treatment, a fixative wire is attached to the back of the teeth to prevent the teeth from returning to their original state.[8]

Retainers

[edit]
Main article: Retainer (orthodontic device)



Hawley retainers are the most common type of retainers. This picture shows retainers for the top (right) and bottom (left) of the mouth.

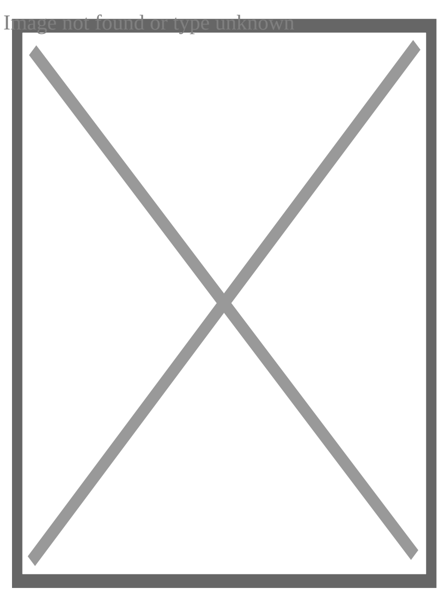
In order to prevent the teeth from moving back to their original position, retainers are worn once the treatment is complete. Retainers help in maintaining and stabilizing the position of teeth long enough to permit the reorganization of the supporting structures after the active phase of orthodontic therapy. If the patient does not wear the retainer appropriately and/or for the right amount of time, the teeth may move towards their previous position. For regular braces, Hawley retainers are used. They are made of metal hooks that surround the teeth and are enclosed by an acrylic plate shaped to fit the patient's palate. For Clear Removable braces, an Essix retainer is used. This is similar to the original aligner; it is a clear plastic tray that is firmly fitted to the teeth and stays in place without a plate fitted to the palate. There is also a bonded retainer where a wire is permanently bonded to the lingual side of the teeth, usually the lower teeth only.

Headgear

[edit]
Main article: Orthodontic headgear

Headgear needs to be worn between 12 and 22 hours each day to be effective in correcting the overbite, typically for 12 to 18 months depending on the severity of the overbite, how much it is worn and what growth stage the patient is in. Typically the prescribed daily wear time will be between 14 and 16 hours a day and is frequently used as a post-primary treatment phase to maintain the position of the jaw and arch. Headgear can be used during the night while the patient sleeps.[9][*better source needed*]

Orthodontic headgear usually consists of three major components:



Full orthodontic headgear with head cap, fitting straps, facebow and elastics

1. Facebow: the facebow (or J-Hooks) is fitted with a metal arch onto headgear tubes attached to the rear upper and lower molars. This facebow then extends out of the mouth and around the patient's face. J-Hooks are different in that they hook into

the patient's mouth and attach directly to the brace (see photo for an example of J-Hooks).
2. Head cap: the head cap typically consists of one or a number of straps fitting around the patient's head. This is attached with elastic bands or springs to the facebow. Additional straps and attachments are used to ensure comfort and safety (see photo).
3. Attachment: typically consisting of rubber bands, elastics, or springs—joins the facebow or J-Hooks and the head cap together, providing the force to move the upper teeth, jaw backwards.

The headgear application is one of the most useful appliances available to the orthodontist when looking to correct a Class II malocclusion. See more details in the section Orthodontic headgear.

Pre-finisher

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The pre-finisher is moulded to the patient's teeth by use of extreme pressure on the appliance by the person's jaw. The product is then worn a certain amount of time with the user applying force to the appliance in their mouth for 10 to 15 seconds at a time. The goal of the process is to increase the exercise time in applying the force to the appliance. If a person's teeth are not ready for a proper retainer the orthodontist may prescribe the use of a preformed finishing appliance such as the pre-finisher. This appliance fixes gaps between the teeth, small spaces between the upper and lower jaw, and other minor problems.

Complications and risks

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A group of dental researchers, Fatma Boke, Cagri Gazioglu, Selvi Akkaya, and Murat Akkaya, conducted a study titled "Relationship between orthodontic treatment and gingival health." The results indicated that some orthodontist treatments result in gingivitis, also known as gum disease. The researchers concluded that functional appliances used to harness natural forces (such as improving the alignment of bites) do not usually have major effects on the gum after treatment.[10] However, fixed appliances such as braces, which most people get, can result in visible plaque, visible inflammation, and gum recession in a majority of the patients. The formation of plaques around the teeth of patients with braces is almost inevitable regardless of plaque control and can result in mild gingivitis. But if someone with braces does not clean their teeth carefully, plaques will form, leading to more severe gingivitis and gum recession.

Experiencing some pain following fitting and activation of fixed orthodontic braces is very common and several methods have been suggested to tackle this.[11][12] Pain associated with orthodontic treatment increases in proportion to the amount of force that is applied to the teeth. When a force is applied to a tooth via a brace, there is a reduction in the blood supply to the fibres that attach the tooth to the surrounding bone. This reduction in blood supply results in inflammation and the release of several chemical factors, which stimulate the pain response. Orthodontic pain can be managed using pharmacological interventions, which involve the use of analgesics applied locally or systemically. These analgesics are divided into four main categories, including opioids, non-steroidal anti-inflammatory drugs (NSAIDs), paracetamol and local anesthesia. The first three of these analgesics are commonly taken systemically to reduce orthodontic pain.[13]

A Cochrane Review in 2017 evaluated the pharmacological interventions for pain relief during orthodontic treatment. The study concluded that there was moderate-quality evidence that analgesics reduce the pain associated with orthodontic treatment. However, due to a lack of evidence, it was unclear whether systemic NSAIDs were more effective than paracetamol, and whether topical NSAIDs were more effective than local anaesthesia in the reduction of pain associated with orthodontic treatment. More high-quality research is required to investigate these particular comparisons.[13]

The dental displacement obtained with the orthodontic appliance determines in most cases some degree of root resorption. Only in a few cases is this side effect large enough to be considered real clinical damage to the tooth. In rare cases, the teeth may fall out or have to be extracted due to root resorption.[14][15]

History

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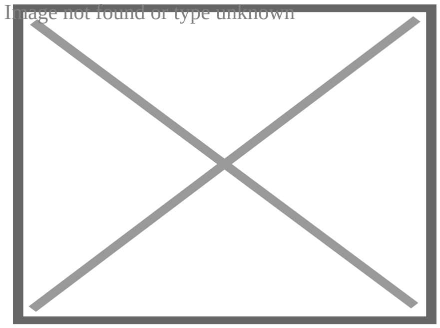
Ancient

[edit]



Old Braces at a museum in Jbeil, Lebanon

According to scholars and historians, braces date back to ancient times. Around 400–300 BC, Hippocrates and Aristotle contemplated ways to straighten teeth and fix various dental conditions. Archaeologists have discovered numerous mummified ancient individuals with what appear to be metal bands wrapped around their teeth. Catgut, a type of cord made from the natural fibres of an animal's intestines, performed a similar role to today's orthodontic wire in closing gaps in the teeth and mouth.[16]

The Etruscans buried their dead with dental appliances in place to maintain space and prevent the collapse of the teeth during the afterlife. A Roman tomb was found with a number of teeth bound with gold wire documented as a ligature wire, a small elastic wire that is used to affix the arch wire to the bracket. Even Cleopatra wore a pair. Roman philosopher and physician Aulus Cornelius Celsus first recorded the treatment of teeth by finger pressure. Unfortunately, due to a lack of evidence, poor preservation of bodies, and primitive technology, little research was carried out on dental braces until around the 17th century, although dentistry was making great advancements as a profession by then.[*citation needed*]

18th century

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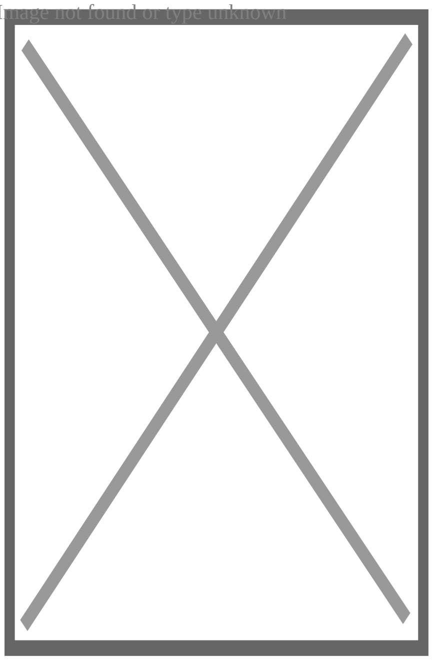

Portrait of Fauchard from his 1728 edition of *"The Surgical Dentist"*.

Orthodontics truly began developing in the 18th and 19th centuries. In 1669, French dentist Pierre Fauchard, who is often credited with inventing modern orthodontics, published a book entitled *"The Surgeon Dentist"* on methods of straightening teeth. Fauchard, in his practice, used a device called a "Bandeau", a horseshoe-shaped piece of iron that helped expand the palate. In 1754, another French dentist, Louis Bourdet, dentist to the King of France, followed Fauchard's book with *The Dentist's Art*, which also dedicated a chapter to tooth alignment and application. He perfected the "Bandeau" and was the first dentist on record to recommend extraction of the premolar teeth to alleviate crowding and improve jaw growth.

19th century

[edit]

Although teeth and palate straightening and/or pulling were used to improve the alignment of remaining teeth and had been practised since early times, orthodontics, as a science of its own, did not really exist until the mid-19th century. Several important dentists helped to advance dental braces with specific instruments and tools that allowed braces to be improved.

In 1819, Christophe François Delabarre introduced the wire crib, which marked the birth of contemporary orthodontics, and gum elastics were first employed by Maynard in 1843. Tucker was the first to cut rubber bands from rubber tubing in 1850. Dentist, writer, artist, and sculptor Norman William Kingsley in 1858 wrote the first article on orthodontics and in 1880, his book, *Treatise on Oral Deformities*, was published. A dentist named John Nutting Farrar is credited for writing two volumes entitled, *A Treatise on the Irregularities of the Teeth and Their Corrections* and was the first to suggest the use of mild force at timed intervals to move teeth.

20th century

[edit]

In the early 20th century, Edward Angle devised the first simple classification system for malocclusions, such as Class I, Class II, and so on. His classification system is still used today as a way for dentists to describe how crooked teeth are, what way teeth are pointing, and how teeth fit together. Angle contributed greatly to the design of orthodontic and dental appliances, making many simplifications. He founded the first school and college of orthodontics, organized the American Society of Orthodontia in 1901 which became the American Association of Orthodontists (AAO) in the 1930s, and founded the first orthodontic journal in 1907. Other innovations in orthodontics in the late 19th and early 20th centuries included the first textbook on orthodontics for children, published by J.J. Guilford in 1889, and the use of rubber elastics, pioneered by Calvin S. Case, along with Henry Albert Baker.

Today, space age wires (also known as dental arch wires) are used to tighten braces. In 1959, the Naval Ordnance Laboratory created an alloy of nickel and titanium called Nitinol. NASA further studied the material's physical properties.[17] In 1979, Dr. George Andreasen developed a new method of fixing braces with the use of the Nitinol wires based on their superelasticity. Andreasen used the wire on some patients and later found out that he could use it for the entire treatment. Andreasen then began using the nitinol wires for all his treatments and as a result, dental doctor visits were reduced, the cost of dental treatment was reduced, and patients reported less discomfort.

See also

[edit]

- icon Image not found or type unknown Medicine portal
- Mandibular advancement splint
- Oral and maxillofacial surgery
- Orthognathic surgery
- Prosthodontics
- Trismus
- Dental implant

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External links

[edit]

- Useful Resources: FAQ and Downloadable eBooks at Orthodontics Australia
- Orthos Explain: Treatment Options at Orthodontics Australia
- Image not found or type unknown Media related to Dental braces at Wikimedia Commons

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Orthodontics

Diagnosis

- Bolton analysis
- Cephalometric analysis
- Cephalometry
- Dentition analysis
- Failure of eruption of teeth
- Little's Irregularity Index
- Malocclusion
- Scissor bite
- Standard anatomical position
- Tooth ankylosis
- Tongue thrust

Conditions	○ Overbite ○ Overjet ○ Open bite ○ Crossbite ○ Dental crowding ○ Dental spacing ○ Bimaxillary Protrusion ○ Prognathism ○ Retrognathism ○ Maxillary hypoplasia ○ Condylar hyperplasia ○ Overeruption ○ Mouth breathing ○ Temperomandibular dysfunction
Appliances	○ ACCO appliance ○ Archwire ○ Activator appliance ○ Braces ○ Damon system ○ Elastics ○ Frankel appliance ○ Invisalign ○ Lingual arch ○ Lip bumper ○ Herbst Appliance ○ List of orthodontic functional appliances ○ List of palatal expanders ○ Lingual braces ○ Headgear ○ Orthodontic technology ○ Orthodontic spacer ○ Palatal lift prosthesis ○ Palatal expander ○ Quad helix ○ Retainer ○ SureSmile ○ Self-ligating braces ○ Splint activator ○ Twin Block Appliance

Procedures	◦ Anchorage (orthodontics) ◦ Cantilever mechanics ◦ Fiberotomy ◦ Interproximal reduction ◦ Intrusion (orthodontics) ◦ Molar distalization ◦ SARPE ◦ Serial extraction
Materials	◦ Beta-titanium ◦ Nickel titanium ◦ Stainless steel ◦ TiMolium ◦ Elgiloy ◦ Ceramic ◦ Composite ◦ Dental elastics

Notable contributors

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- Spencer Atkinson
- Clifford Ballard
- Raymond Begg
- Hans Peter Bimler
- Samir Bishara
- Arne Björk
- Charles B. Bolton
- Holly Broadbent Sr.
- Allan G. Brodie
- Charles J. Burstone
- Peter Buschang
- Calvin Case
- Harold Chapman (Orthodontist)
- David Di Biase
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About tooth

This article is about teeth in general. For specifically human teeth, see Human tooth. For other uses, see Tooth (disambiguation).

Tooth

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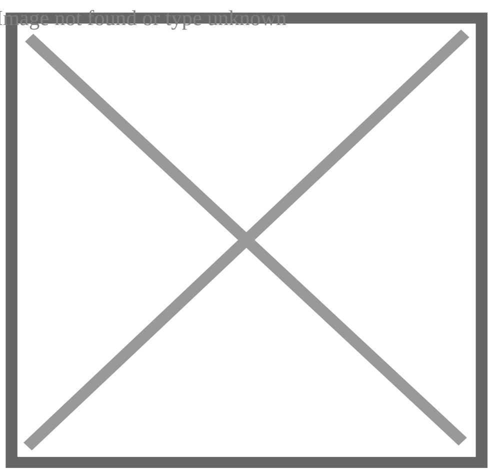

A chimpanzee displaying his teeth

Details

Identifiers	
Latin	*dens*
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Anatomical terminology
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A **tooth** (pl.: **teeth**) is a hard, calcified structure found in the jaws (or mouths) of many vertebrates and used to break down food. Some animals, particularly carnivores and omnivores, also use teeth to help with capturing or wounding prey, tearing food, for defensive purposes, to intimidate other animals often including their own, or to carry prey or their young. The roots of teeth are covered by gums. Teeth are not made of bone, but rather of multiple tissues of varying density and hardness that originate from the outermost embryonic germ layer, the ectoderm.

The general structure of teeth is similar across the vertebrates, although there is considerable variation in their form and position. The teeth of mammals have deep roots, and this pattern is also found in some fish, and in crocodilians. In most teleost fish, however, the teeth are attached to the outer surface of the bone, while in lizards they are attached to the inner surface of the jaw by one side. In cartilaginous fish, such as sharks, the teeth are attached by tough ligaments to the hoops of cartilage that form the jaw.[1]

Monophyodonts are animals that develop only one set of teeth, while diphyodonts grow an early set of deciduous teeth and a later set of permanent or "adult" teeth. Polyphyodonts grow many sets of teeth. For example, sharks, grow a new set of teeth every two weeks to replace worn teeth. Most extant mammals including humans are diphyodonts, but there are exceptions including elephants, kangaroos, and manatees, all of which are polyphyodonts.

Rodent incisors grow and wear away continually through gnawing, which helps maintain relatively constant length. The industry of the beaver is due in part to this qualification. Some rodents, such as voles and guinea pigs (but not mice), as well as lagomorpha (rabbits, hares and pikas), have continuously growing molars in addition to incisors.[2][3] Also, tusks (in tusked mammals) grow almost throughout life.[4]

Teeth are not always attached to the jaw, as they are in mammals. In many reptiles and fish, teeth are attached to the palate or to the floor of the mouth, forming additional rows inside those on the jaws proper. Some teleosts even have teeth in the pharynx. While not true teeth in the usual sense, the dermal denticles of sharks are almost identical in structure and are likely to have the same evolutionary origin. Indeed, teeth appear to have first evolved in sharks, and are not found in the more primitive jawless fish – while lampreys do have tooth-like structures on the tongue, these are in fact, composed of keratin, not of dentine or enamel, and bear no relationship to true teeth.[1] Though "modern" teeth-like structures with dentine and enamel have been found in late conodonts, they are now supposed to have evolved independently of later vertebrates' teeth.[5][6]

Living amphibians typically have small teeth, or none at all, since they commonly feed only on soft foods. In reptiles, teeth are generally simple and conical in shape, although there is some variation between species, most notably the venom-injecting fangs of snakes. The pattern of incisors, canines, premolars and molars is found only in mammals, and to varying extents, in their evolutionary ancestors. The numbers of these types of teeth vary greatly between species; zoologists use a standardised dental formula to describe the precise pattern in any given group.[1]

Etymology

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The word *tooth* comes from Proto-Germanic **tanþs*, derived from the Proto-Indo-European **hÃ¢â€šÂ•dent-*, which was composed of the root **hÃ¢â€šÂ•ed-*'to eat' plus the active participle suffix **-nt*, therefore literally meaning 'that which eats'.[7]

The irregular plural form *teeth* is the result of Germanic umlaut whereby vowels immediately preceding a high vocalic in the following syllable were raised. As the nominative plural ending of the Proto-Germanic consonant stems (to which **tanþs* belonged) was **-iz*, the root vowel in the plural form **tanþiz* (changed by this point to * *tÃ„â€¦ÃŒâ€žþi* via unrelated phonological processes) was raised to /œÃ‹Â•/, and later unrounded to /eÃ‹Â•/, resulting in the*tÃ…Â•þ/tÃ„â€œþ*alternation attested from Old English. Cf. also Old English *bÃ…Â•c/bÃ„â€œÃ„â€¹*'book/books' and 'mÃ…Â«s/mÃˆÂ³s' 'mouse/mice', from Proto-Germanic **bÃ…Â•ks/bÃ…Â•kiz*and **mÃ…Â«s/mÃ…Â«siz* respectively.

Cognate with Latin *dÃ„â€œns*, Greek Ã¡Â½â‚¬??Ã•Â•Ž(*odous*), and Sanskrit *dát*.

Origin

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Teeth are assumed to have evolved either from ectoderm denticles (scales, much like those on the skin of sharks) that folded and integrated into the mouth (called the "outside–in" theory), or from endoderm pharyngeal teeth (primarily formed in the pharynx of jawless vertebrates) (the "inside–out" theory). In addition, there is another theory stating that neural crest gene regulatory network, and neural crest-derived ectomesenchyme are the key to generate teeth (with any epithelium, either ectoderm or endoderm).[4][8]

The genes governing tooth development in mammals are homologous to those involved in the development of fish scales.[9] Study of a tooth plate of a fossil of the extinct fish *Romundina stellina* showed that the teeth and scales were made of the same tissues, also found in mammal teeth, lending support to the theory that teeth evolved as a modification of scales.[10]

Mammals

[edit]
Main article: Mammal tooth

Teeth are among the most distinctive (and long-lasting) features of mammal species. Paleontologists use teeth to identify fossil species and determine their relationships. The shape of the animal's teeth are related to its diet. For example, plant matter is hard to digest, so herbivores have many molars for chewing and grinding. Carnivores, on the other hand, have canine teeth to kill prey and to tear meat.

Mammals, in general, are diphyodont, meaning that they develop two sets of teeth. In humans, the first set (the "baby", "milk", "primary" or "deciduous" set) normally starts to appear at about six months of age, although some babies are born with one or more visible teeth, known as neonatal teeth. Normal tooth eruption at about six months is known as teething and can be painful. Kangaroos, elephants, and manatees are unusual among mammals because they are polyphyodonts.

Aardvark

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In aardvarks, teeth lack enamel and have many pulp tubules, hence the name of the order Tubulidentata.[11]

Canines

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In dogs, the teeth are less likely than humans to form dental cavities because of the very high pH of dog saliva, which prevents enamel from demineralizing.[12] Sometimes called cuspids, these teeth are shaped like points (cusps) and are used for tearing and grasping food.[13]

Cetaceans

[edit]
Main article: Baleen

Like human teeth, whale teeth have polyp-like protrusions located on the root surface of the tooth. These polyps are made of cementum in both species, but in human teeth, the protrusions are located on the outside of the root, while in whales the nodule is located on the inside of the pulp chamber. While the roots of human teeth are made of cementum on the outer surface, whales have cementum on the entire surface of the tooth with a very small layer of enamel at the tip. This small enamel layer is only seen in older whales where the cementum has been worn away to show the underlying enamel.[14]

The toothed whale is a parvorder of the cetaceans characterized by having teeth. The teeth differ considerably among the species. They may be numerous, with some dolphins bearing over 100 teeth in their jaws. On the other hand, the narwhals have a giant unicorn-like tusk, which is a tooth containing millions of sensory pathways and used for sensing during feeding, navigation, and mating. It is the most neurologically complex tooth known. Beaked whales are almost toothless, with only bizarre teeth found in males. These teeth may be used for feeding but also for demonstrating aggression and showmanship.

Primates

[edit]
Main articles: Human tooth and Dental anatomy

In humans (and most other primates), there are usually 20 primary (also "baby" or "milk") teeth, and later up to 32 permanent teeth. Four of these 32 may be third molars or wisdom teeth, although these are not present in all adults, and may be removed surgically later in life.[15]

Among primary teeth, 10 of them are usually found in the maxilla (i.e. upper jaw) and the other 10 in the mandible (i.e. lower jaw). Among permanent teeth, 16 are found in the maxilla and the other 16 in the mandible. Most of the teeth have uniquely distinguishing features.

Horse

[edit]
Main article: Horse teeth

An adult horse has between 36 and 44 teeth. The enamel and dentin layers of horse teeth are intertwined.[16] All horses have 12 premolars, 12 molars, and 12 incisors.[17] Generally, all male equines also have four canine teeth (called tushes) between the molars and incisors. However, few female horses (less than 28%) have canines, and those that do usually have only one or two, which many times are only partially erupted.[18] A few horses have one to four wolf teeth, which are vestigial premolars, with most of those having only one or two. They are equally common in male and female horses and much more likely to be on the upper jaw. If present these can cause problems as they can interfere with the horse's bit contact. Therefore, wolf teeth are commonly removed.[17]

Horse teeth can be used to estimate the animal's age. Between birth and five years, age can be closely estimated by observing the eruption pattern on milk teeth and then permanent teeth. By age five, all permanent teeth have usually erupted. The horse is then said to have a "full" mouth. After the age of five, age can only be conjectured by studying the wear patterns on the incisors, shape, the angle at which the incisors meet, and other factors. The wear of teeth may also be affected by diet, natural abnormalities, and cribbing. Two horses of the same age may have different wear patterns.

A horse's incisors, premolars, and molars, once fully developed, continue to erupt as the grinding surface is worn down through chewing. A young adult horse will have teeth, which are 110–130 mm (4.5–5 inches) long, with the majority of the crown remaining below the gumline in the dental socket. The rest of the tooth will slowly emerge from the jaw, erupting about 3 mm (1?8 in) each year, as the horse ages. When the animal reaches old age, the crowns of the teeth are very short and the teeth are often lost altogether. Very old horses, if lacking molars, may need to have their fodder ground up and soaked in water to create a soft mush for them to eat in order to obtain adequate nutrition.

Proboscideans

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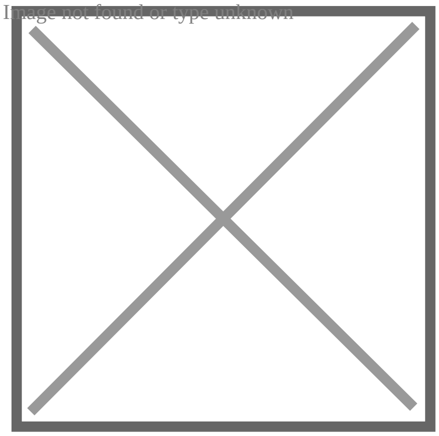

Section through the ivory tusk of a mammoth

Main article: Elephant ivory

Elephants' tusks are specialized incisors for digging food up and fighting. Some elephant teeth are similar to those in manatees, and elephants are believed to have undergone an aquatic phase in their evolution.

At birth, elephants have a total of 28 molar plate-like grinding teeth not including the tusks. These are organized into four sets of seven successively larger teeth which the elephant will slowly wear through during its lifetime of chewing rough plant material. Only four teeth are used for chewing at a given time, and as each tooth wears out, another tooth moves forward to take its place in a process similar to a conveyor belt. The last and largest of these teeth usually becomes exposed when the animal is around 40 years of age, and will often last for an additional 20 years. When the last of these teeth has fallen out, regardless of the elephant's age, the animal will no longer be able to chew food and will die of starvation.[[19]][[20]]

Rabbit

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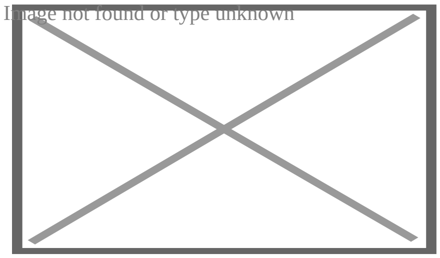
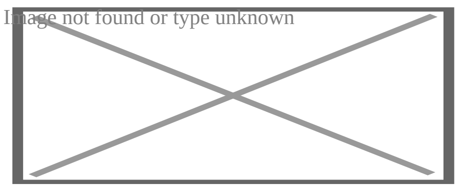
Rabbits and other lagomorphs usually shed their deciduous teeth before (or very shortly after) their birth, and are usually born with their permanent teeth.[[21]] The teeth of rabbits complement their diet, which consists of a wide range of vegetation. Since many of the foods are abrasive enough to cause attrition, rabbit teeth grow continuously throughout life.[[22]] Rabbits have a total of six incisors, three upper premolars, three upper molars, two lower premolars, and two lower molars on each side. There are no canines. Dental formula is $\frac{2.0.3.3}{1.0.2.3}$ = 28. Three to four millimeters of the tooth is worn away by incisors every week, whereas the cheek teeth require a month to wear away the same amount.[

[23]

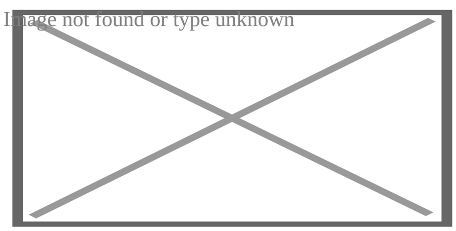
The incisors and cheek teeth of rabbits are called aradicular hypsodont teeth. This is sometimes referred to as an elodent dentition. These teeth grow or erupt continuously. The growth or eruption is held in balance by dental abrasion from chewing a diet high in fiber.



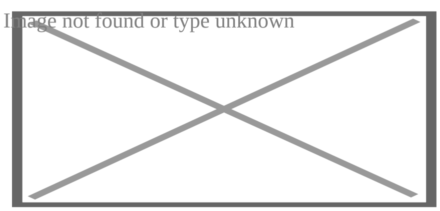
Buccal view of top incisor from *Rattus rattus*. Top incisor outlined in yellow. Molars circled in blue.



Buccal view of the lower incisor from the right dentary of a *Rattus rattus*



Lingual view of the lower incisor from the right dentary of a *Rattus rattus*



Midsagittal view of top incisor from *Rattus rattus*. Top incisor outlined in yellow. Molars circled in blue.

Rodents

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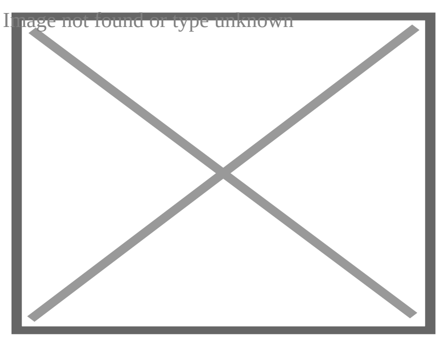
Rodents have upper and lower hypselodont incisors that can continuously grow enamel throughout its life without having properly formed roots.[24] These teeth are also known as aradicular teeth, and unlike humans whose ameloblasts die after tooth development, rodents continually produce enamel, they must wear down their teeth by gnawing on various materials.[25] Enamel and dentin are produced by the enamel organ, and growth is dependent on the presence of stem cells, cellular amplification, and cellular maturation structures in the odontogenic region.[26] Rodent incisors are used for cutting wood, biting through the skin of fruit, or for defense. This allows for the rate of wear and tooth growth to be at equilibrium.[24] The microstructure of rodent incisor enamel has shown to be useful in studying the phylogeny and systematics of rodents because of its independent evolution from the other dental traits. The enamel on rodent incisors are composed of two layers: the inner portio interna (PI) with Hunter-Schreger bands (HSB) and an outer portio externa (PE) with radial enamel (RE).[27] It usually involves the differential regulation of the epithelial stem cell niche in the tooth of two rodent species, such as guinea pigs.[28][29]



Lingual view of top incisor from Rattus rattus. Top incisor outlined in yellow. Molars circled in blue.

The teeth have enamel on the outside and exposed dentin on the inside, so they self-sharpen during gnawing. On the other hand, continually growing molars are found in some rodent species, such as the sibling vole and the guinea pig.[28][29] There is variation in the dentition of the rodents, but generally, rodents lack canines and premolars, and have a space between their incisors and molars, called the diastema region.

Manatee

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Manatees are polyphyodont with mandibular molars developing separately from the jaw and are encased in a bony shell separated by soft tissue.[30][31]

Walrus

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Main article: Walrus ivory

Walrus tusks are canine teeth that grow continuously throughout life.[32]

Fish

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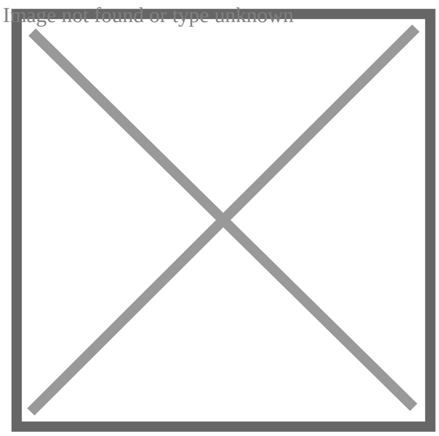

Teeth of a great white shark

See also: Pharyngeal teeth and Shark tooth

Fish, such as sharks, may go through many teeth in their lifetime. The replacement of multiple teeth is known as polyphyodontia.

A class of prehistoric shark are called cladodonts for their strange forked teeth.

Unlike the continuous shedding of functional teeth seen in modern sharks,[33][34] the majority of stem chondrichthyan lineages retained all tooth generations developed throughout the life of the animal.[35] This replacement mechanism is exemplified by the tooth whorl-based dentitions of acanthodians,[36] which include the oldest known toothed vertebrate, *Qianodus duplicis*[37].

Amphibians

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All amphibians have pedicellate teeth, which are modified to be flexible due to connective tissue and uncalcified dentine that separates the crown from the base of the tooth.[38]

Most amphibians exhibit teeth that have a slight attachment to the jaw or acrodont teeth. Acrodont teeth exhibit limited connection to the dentary and have little enervation.[39] This is ideal for organisms who mostly use their teeth for grasping, but not for crushing and allows for rapid regeneration of teeth at a low energy cost. Teeth are usually lost in the course of feeding if the prey is struggling. Additionally, amphibians that undergo a metamorphosis develop bicuspid shaped teeth.[40]

Reptiles

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The teeth of reptiles are replaced constantly throughout their lives. Crocodilian juveniles replace teeth with larger ones at a rate as high as one new tooth per socket every month. Once mature, tooth replacement rates can slow to two years and even longer. Overall, crocodilians may use 3,000 teeth from birth to death. New teeth are created within old teeth.[41]

Birds

[edit]
Main article: Ichthyornis

A skull of Ichthyornis discovered in 2014 suggests that the beak of birds may have evolved from teeth to allow chicks to escape their shells earlier, and thus avoid predators and also to penetrate protective covers such as hard earth to access underlying food.[42][43]

Invertebrates

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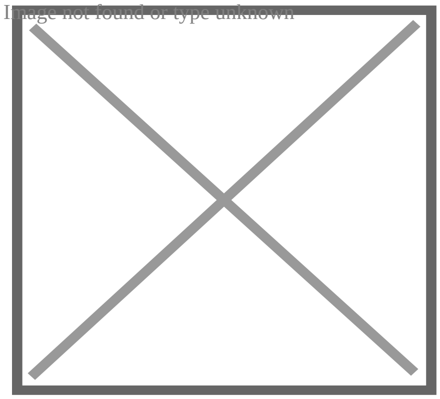
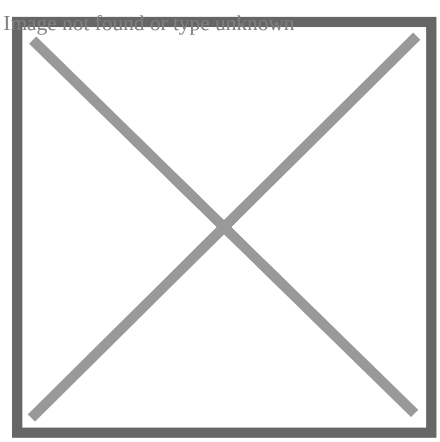


The European medicinal leech has three jaws with numerous sharp teeth which function like little saws for incising a host.

True teeth are unique to vertebrates,[44] although many invertebrates have analogous structures often referred to as teeth. The organisms with the simplest genome bearing such tooth-like structures are perhaps the parasitic worms of the family Ancylostomatidae.[45] For example, the hookworm *Necator americanus* has two dorsal and two ventral cutting plates or teeth around the anterior margin of the buccal capsule. It also has a pair of subdorsal and a pair of subventral teeth located close to the rear.[46]

Historically, the European medicinal leech, another invertebrate parasite, has been used in medicine to remove blood from patients.[47] They have three jaws (tripartite) that resemble saws in both appearance and function, and on them are about 100 sharp teeth used to incise the host. The incision leaves a mark that is an inverted Y inside of a circle. After piercing the skin and injecting anticoagulants (hirudin) and anaesthetics, they suck out blood, consuming up to ten times their body weight in a single meal.[48]

In some species of Bryozoa, the first part of the stomach forms a muscular gizzard lined with chitinous teeth that crush armoured prey such as diatoms. Wave-like peristaltic contractions then move the food through the stomach for digestion.[49]



The limpet rasps algae from rocks using teeth with the strongest known tensile strength of any biological material.

Molluscs have a structure called a radula, which bears a ribbon of chitinous teeth. However, these teeth are histologically and developmentally different from vertebrate teeth and are unlikely to be homologous. For example, vertebrate teeth develop from a neural crest mesenchyme-derived dental papilla, and the neural crest is specific to vertebrates, as are tissues such as enamel.[44]

The radula is used by molluscs for feeding and is sometimes compared rather inaccurately to a tongue. It is a minutely toothed, chitinous ribbon, typically used for scraping or cutting food before the food enters the oesophagus. The radula is unique to molluscs, and is found in every class of mollusc apart from bivalves.

Within the gastropods, the radula is used in feeding by both herbivorous and carnivorous snails and slugs. The arrangement of teeth (also known as denticles) on the radula ribbon varies considerably from one group to another as shown in the diagram on the left.

Predatory marine snails such as the Naticidae use the radula plus an acidic secretion to bore through the shell of other molluscs. Other predatory marine snails, such as the Conidae, use a specialized radula tooth as a poisoned harpoon. Predatory pulmonate land slugs, such as the ghost slug, use elongated razor-sharp teeth on the radula to seize and devour earthworms. Predatory cephalopods, such as squid, use the radula for cutting prey.

In most of the more ancient lineages of gastropods, the radula is used to graze by scraping diatoms and other microscopic algae off rock surfaces and other substrates. Limpets scrape algae from rocks using radula equipped with exceptionally hard rasping teeth.[50] These teeth have the strongest known tensile strength of any biological material, outperforming spider silk.[50] The mineral protein of the limpet teeth can withstand a tensile stress of 4.9 GPa, compared to 4 GPa of spider silk and 0.5 GPa of human teeth.[51]

Fossilization and taphonomy

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Because teeth are very resistant, often preserved when bones are not,[52] and reflect the diet of the host organism, they are very valuable to archaeologists and palaeontologists.[53] Early fish such as the thelodonts had scales composed of dentine and an enamel-like compound, suggesting that the origin of teeth was from scales which were retained in the mouth. Fish as early as the late Cambrian had dentine in their exoskeletons, which may have functioned in defense or for sensing their environments.[54] Dentine can be as hard as the rest of teeth and is composed of collagen fibres, reinforced with hydroxyapatite.[54]

Though teeth are very resistant, they also can be brittle and highly susceptible to cracking.[55] However, cracking of the tooth can be used as a diagnostic tool for predicting bite force. Additionally, enamel fractures can also give valuable insight into the diet and behaviour of archaeological and fossil samples.

Decalcification removes the enamel from teeth and leaves only the organic interior intact, which comprises dentine and cementine.[56] Enamel is quickly decalcified in acids,[57] perhaps by dissolution by plant acids or via diagenetic solutions, or in the stomachs of vertebrate predators.[56] Enamel can be lost by abrasion or spalling,[56] and is lost before dentine or bone are destroyed by the fossilisation process.[57] In such a case, the 'skeleton' of the teeth would consist of the dentine, with a hollow pulp cavity.[56] The organic part of dentine, conversely, is destroyed by alkalis.[57]

See also

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- icon Image not found or type unknown Medicine portal
- Animal tooth development
- Dragon's teeth (mythology)

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