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- **Indications for Surgical Alignment of the Jaw**  
**Indications for Surgical Alignment of the Jaw Steps in Preparing for Orthognathic Procedures Collaboration Between Orthodontists and Surgeons Recovery Factors That Affect Surgical Outcomes Managing Expectations During Corrective Jaw Treatment Potential Complications of Complex Jaw Adjustments Importance of Skeletal Analysis Before Surgery Combined Orthodontic and Surgical Treatment Timelines Role of Virtual Surgical Planning in Jaw Corrections Functional Improvements After Orthognathic Intervention Support and Care for Post Surgical Recovery Evaluating Long Term Benefits of Jaw Realignment**
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In pediatric care, orthodontic surgery, often referred to as orthognathic surgery, plays a crucial role in addressing severe jaw misalignments and bite issues that cannot be fully corrected with traditional orthodontic treatments. This type of surgery is essential for correcting problems such as overbite, underbite, crossbite, and open bite, which can significantly impact a child's ability to chew, speak, and even breathe properly. Misaligned jaws can also put teeth at risk of becoming worn down and can cause discomfort or pain in the jaw, known as temporomandibular joint (TMJ) disorders.

The necessity of orthodontic surgery in pediatric care is further supported by the long-term benefits it offers. By correcting jaw misalignment, surgery can improve facial aesthetics, chewing function, and speech clarity. Additionally, it can alleviate breathing difficulties and reduce the risk of TMJ disorders, contributing to an enhanced quality of life for the child.

Recovery from orthognathic surgery involves several factors that can significantly impact surgical outcomes. Initially, patients are placed on a liquid or soft diet to allow the jaw to heal properly, gradually reintroduce more solid foods as healing progresses. Some children may need space maintainers to prevent crowding **Kids' dental alignment services** disease. Proper oral hygiene is critical to prevent infection, and patients often require follow-up orthodontic treatments to fine-tune their bite alignment. The success rate of orthognathic surgery is remarkably high, with most patients reporting significant improvements in their quality of life and satisfaction with the results.

In pediatric care, the success of orthognathic surgery is not only measured by the surgical outcome but also by the child's overall satisfaction and improvements in their quality of life. A multidisciplinary approach, including orthodontists, oral surgeons, and other healthcare professionals, ensures that each child's unique needs are addressed, contributing to the high success rate of the procedure. By understanding the necessity and recovery factors of orthodontic surgery, healthcare teams can provide effective care and support to pediatric patients undergoing this transformative treatment.

Recovery factors that influence surgical outcomes are diverse and play a crucial role in determining the speed and extent of postoperative recovery. Research has shown that psychosocial factors, including depression and social support, are significant predictors of surgical outcomes, even after accounting for clinical factors like presurgical health status[1]. Attitudinal and mood factors are particularly predictive, while personality factors have been found to be less so[1]. This suggests that preoperative consideration of these factors can help healthcare practitioners in estimating recovery.

Psychological well-being is another critical preoperative risk that can influence recovery. Factors associated with poor multidimensional recovery include ASA grade, recovery tool baseline score, physical function, number of co-morbidities, previous surgery, and psychological well-being[3]. Mixed results have been reported for age, BMI, and preoperative pain, highlighting the need for more consistent and high-quality studies[3]. The quality of evidence in this field is rated from very low to low, primarily attributed to the observational nature and heterogeneity of studies[3]. This indicates a need for further research to establish more reliable predictors of recovery.

Enhanced Recovery After Surgery (ERAS) guidelines have been shown to improve surgical outcomes by decreasing hospital length of stay and complications. ERAS elements, including early mobilization and postoperative analgesia, are associated with these positive outcomes[5]. The implementation of ERAS protocols can be influenced by the type of surgery and the number of ERAS elements applied, with procedures like pancreatic and orthopedic surgery often having greater reductions in hospital stays[5]. This suggests that standardized and comprehensive approaches to recovery can have a significant positive influence on surgical outcomes.

The role of healthcare systems in recovery is also important. Nursing programs emphasize the need for competent care and proper documentation, which are essential for ensuring that patients are well supported during their recovery[4]. However, the specific requirements and outcomes of these programs can be influenced by factors like program length and student performance criteria[4]. In conclusion, recovery factors that influence surgical outcomes are multi-dimensional, including both psychosocial and clinical elements, as well as systemic approaches like ERAS guidelines.

## **\*\*The HealthyStart System\*\***

The recovery process following surgery in children is a highly individualized experience, significantly influencing the overall outcome. Factors such as the type of surgery, the child's overall health, and the quality of post-operative care play critical, yet diverse, effects on how well a child recovers.

**The type of surgery** is a primary factor that can impact recovery. For example, children undergoing major procedures like brain surgery or spinal fusion may experience more discomfort and require longer recovery time. In the case of brain surgery, children may feel fatigued for several months and need more rest, while also being at risk for complications like infection or pain at the surgical site[1]. In spinal fusion surgery, adolescents may face persistent pain and functional difficulties, making psychological support essential for their recovery[3]. The specific surgical procedure can also affect the level of post-operative pain and the need for pain management strategies.

**The child's overall health** before surgery is also a critical factor. Children with existing health problems may face additional risks during recovery, such as increased infection risk or complications from anesthesia. For example, children with chronic health problems may require more time to recover and may need more hospitalization days. Moreover, their ability to cope with post-operative pain and discomfort can be significantly different from that of a healthy child, making it essential to consider their health history when developing a recovery care.

**The quality of post-operative care** is a further critical factor that can significantly impact recovery outcomes. This includes not only the physical care provided by nurses and doctors but also the emotional support from parents and other care team. For children, having a trusted caregiver can be particularly important, as it helps them feel safe and comforted during a stressful time[5]. Encourage children to drink plenty of fluids and rest when needed, while also gradually building up their physical activities as per the surgeon's advice[1]. Moreover, effective pain management is essential to prevent chronic pain and promote a faster recovery[3]. In some cases, hospitals may offer "enhanced recovery strategies, which include early eating, early physical activities, and better pain management, all of which can lead to a faster and more comfortable recovery[2]."

In addition to these factors, **the child's age and previous hospital experiences** can also affect their recovery. For example, infants may require more attention to their emotional needs post-surgery, while adolescents may benefit from more open communication about their recovery process[5]. The support and understanding from the school can also play a critical role in the recovery process, especially for children needing to gradually increase their school hours[1]. In all cases, a well-planned recovery process that includes these factors can lead to better outcomes and a faster recovery for children undergoing surgery.





**This non-invasive approach targets the natural development of children's teeth and jaw, using soft**

# dental appliances to align teeth and address breathing issues, reducing the need for more invasive treatments.

Post-surgical care for pediatric orthodontic surgery, such as orthognathic surgery, is crucial for ensuring optimal recovery and outcomes. The recovery process is a critical phase where several factors can affect surgical results.

## Immediate Postoperative Care

In the immediate postoperative period, pain management is a major concern. Effective pain control often requires prescribed medications, and in some cases, additional interventions may be necessary for patients experiencing refractory pain. Ice packs can help manage swelling, while moist heat may alleviate discomfort in the jaw muscles. It is essential for patients to follow postoperative instructions closely to avoid any immediate post-surgical issues.

## Recovery Factors Affecting Outcomes

1. **Follow-Up Appointments and Oral Hygiene** - Regular follow-up appointments with both the orthodontist and oral surgeon are crucial for monitoring healing progress. Patients must also adhere to a high standard of oral care to avoid any postoperative issues like dental or surgical sites.

2.

**Postoperative Diet** - Transitioning from a soft diet to regular foods under healthcare guidance is important. This gradual transition is necessary to ensure that the jaw and mouth heal properly without irritation.

3. **ERAS (Enhanced Recovery After Surgery) protocols** - While not widely established for pediatric orthognathic surgery, ERAS elements such as hypothermia prevention, normovolemia maintenance, and minimized opioid use can improve recovery outcomes. However, surgeons often need more education on certain ERAS elements like preoperative nutritional screening and goal-directed fluid therapy.
  
4. **Rest and Emotional Support** - Patients should rest and avoid strenuous activity until cleared by their surgeon. Emotional support is also important, as recovery can be a difficult time both physiognomical and physiognomical.
  
5. **Surgical Complications** - Common surgical issues include hardware irritation, neurosensory alterations like numbness, and the need for hardware removal. These factors can affect recovery and require close monitoring by healthcare professionals.

In general, recovery from orthognathic surgery can take about two to three months, with patients typically out of work or school for at least one month. The recovery process is tailored to each patient's specific health and surgical factors. By following these guidelines and collaborating closely with healthcare professionals, patients can navigate the recovery phase effectively, achieving optimal healing and restoring oral function.



# **\*\*Myobrace: A No-Braces Approach\*\***

When it's time to focus on recovery factors that impact surgical outcomes, several key elements become crucial. These include rest, diet, and follow-up visits, all of which are essential for ensuring proper healing and addressing any complications that may have been caused by the surgery. The process of recovery is not just about physical healing but also about addressing psychological and social factors that influence a patient's ability to return to normal life.

## **Psychosocial Factors and Recovery**

Psychosocial factors, such as depression, social support, and patient mood, play a significant role in recovery. Research indicates that these factors can be predictive of surgical outcomes, even when accounting for clinical variables like presurgical health status[1]. For example, patients with positive mental states and support from family and friends often experience more effective and efficient recovery. This emphasizes the importance of addressing mental health during the recovery process.

## **The Enhanced Recovery After Surgery (ERAS) Guidelines**

The Enhanced Recovery After Surgery (ERAS) guidelines provide a structured protocol for postoperative care, which includes early mobilization, postoperative analgesia management, and dietary considerations[3]. Implementing these guidelines has been associated with a decrease in hospital length of stay and complications. This systematic and evidence-based care can improve patient outcomes by ensuring that all necessary steps are taken to support recovery.

## **Importance of Nutrition**

A well-optimizing diet is essential for recovery. Nutrition support is critical for patients who are unable to meet their nutrient needs, as malnutrition can impair recovery and precipitate complications[4]. For surgical patients, malnutrition can result in increased complications and mortality rates. Nutrition support can be provided in various form, such as oral supplementation or tube feeding, and should be considered based on the patient's specific needs.

## **Follow-up and Patient-centered Recovery**

Follow-up visits are crucial for monitoring healing and addressing any complications early. However, recovery is not just about clinical parameters; it also includes returning to preoperative habits and routines, resolving symptoms, overcoming mental strains, regaining independence, and enjoying life[5]. Patients often define recovery by their ability to return to normal activities and social interactions, which underlines the need for patient-centered care strategies.

In summary, effective recovery from surgery requires a comprehensive and multidisciplinary care that includes rest, diet, follow-up visits, and consideration of psychosocial factors. Implementing evidence-based protocols like ERAS and addressing nutritional needs can improve outcomes, while understanding patient perspectives can help in developing more effective recovery strategies.





**Myobrace offers a brace-free solution that corrects poor oral habits, guiding jaw and teeth**

# alignment development in children, promoting natural growth and oral health.

Emotional support and communication play a crucial role in the recovery process following surgery, significantly impacts surgical outcome. The journey of recovery is not just about physical healing but also about managing the emotional and psychological challenges that often come with it. Open communication is essential for addressing these challenges, as it fosters a nurturing environment where patients feel supported and cared for.

After surgery, patients often experience a range of emotions, from fear and anxiety to sadness and uncertainty. This emotional response can be overwhelming and may hinder the recovery process if not properly addressed. Emotional support from family, friends, support groups, and mental health providers can help manage these emotions by offering comfort, empathy, and a sense of control. When patients feel supported, they are more likely to communicate their needs and concerns to healthcare providers, which can lead to better pain management and adherence to rehabilitation plans.

Communication is a two way process that not only helps in expressing emotional needs but also in receiving appropriate care and guidance. Open lines of communication allow healthcare providers to understand the emotional state of their patients and make necessary adjustments to the treatment plan. This proactive communication empowers patients to take control of their recovery, leading to improved mental well-being and a faster healing process.

Emotional support also has a positive physical outcome. It can reduce stress and anxiety, which are associated with enhanced immune response, faster wound healing, and better sleep quality. A robust support system encourages patients to stay motivated and committed to their treatment plans, even during periods of low mood or frustration. This commitment is crucial for achieving optimal recovery and long-term health benefits.

In summary, emotional support and communication are vital recovery tools that enhance the healing process by addressing both the psychological and physical challenges of surgery. By prioritizing emotional well-being alongside physical recovery, individuals can navigate the post-surgery journey with resilience and achieve a more positive and successful outcome.

# **\*\*Comprehensive Orthodontic Solutions\*\***

When it comes to recovery from surgery, especially in the care of a child, emotional support and open communication play a critical role in ensuring a positive recovery experience. The emotional well-being of a child during this time can be just as important as their physical health, as it directly influences their ability to recover and their long-term outcomes.

Psychosocial factors, such as emotional support and communication, have been found to be significant predictors of surgical outcomes. Research indicates that these factors can influence recovery speed and extent, even when accounting for clinical variables like presurgical health status[1]. For a child, having a supportive environment where they can understand what is being offered can help in reducing their mental strains and enhance their recovery process.

In the recovery process, open communication is essential. It not only provides the child with a sense of control and understanding but also offers them the ability to share their experiences and needs. This can lead to better pain management, reduced postoperative complications, and a more positive emotional state. For example, studies have found that patients who are more actively included in their care and recovery process often have better outcomes and are more likely to follow postoperative instructions[5]. This approach can also help in addressing any potential mental health challenges that may occur during recovery.

The role of family and support systems in this process is also critical. They can provide the necessary emotional support and help in ensuring that the child is well-informed about their recovery. This support can extend beyond the hospital stay, helping the child to readjust to their habits and routines, which is a significant step in the recovery journey[5]. In summary, emotional support and open communication are not just additional benefits but are essential factors that contribute to a positive recovery experience for a child undergoing surgery. They help in addressing both the physical and emotional needs of the child, ensuring a more holistic recovery process.

When it concerns pediatric orthodontic surgery, the management of anesthesia and pain during recovery is crucial for ensuring optimal surgical outcomes. Enhanced Recovery After Surgery (ERAS) protocols, which have been widely adopted in many surgical specialties, focus on minimizing surgical stress and optimizing recovery. In the field of pediatric orthognathic surgery, while these protocols are not as formalized, elements such as hypothermia prevention, normovolemia maintenance, and intraoperative tranexamic acid use are commonly employed to improve patient recovery[1]. However, there is a need for further education and standardization of ERAS protocols tailored to pediatric patients.

Anesthesia management is a critical recovery issue. The use of local anesthetic blocks, such as inferior alveolar nerve blocks, can lead to temporary or, in some cases, permanent paresthesia, although the incidence is very high[2]. This underscores the importance of precise technique and patient monitoring during anesthesia.

In the recovery phase, pain management is a major concern. Effective pain control often requires a multidisciplinary approach, including medication and alternative techniques like jaw immobilization. The transition from a soft diet to regular foods and regular follow-up appointments are essential for progressive recovery[3]. Emotional support also cannot be overemphasized as patients may experience neurosensory alterations such as numbness or altered sensations, which typically resolve over time[3]. The overall recovery time for orthognathic surgery can vary, typically taking about two to three months, depending on factors like the type of surgery and patient health[5]. By understanding and effectively implementing these recovery factors, healthcare professionals can improve surgical outcomes and provide a more comprehensive care experience for pediatric patients undergoing orthodontic surgery.

When it comes to surgical procedures, especially in children, anesthesia is a comprehensive and effective method to ensure pain relief during and after the surgery. This section will look at the use of anesthesia and how it helps in pain recovery, ensuring the child's comfort throughout the surgical experience.

Anesthesia is designed to prevent pain during surgical procedures, and it is a safe and effective way to ensure that children remain comfortable throughout the surgery. There are several types of anesthesia, each with different effects and recovery time. General anesthesia, for example, makes the child lose consciousness, while regional anesthesia numbs a specific part of the body, such as the lower back or extremities. This type of anesthesia is often recommended for children because it reduces the risk of neurotoxicity, which can be a potential side effect of general anesthesia, especially in young children undergoing multiple or long procedures[2][4]. Regional anesthesia also has the benefit of faster recovery, less nausea, and a lower need for opioid pain medications post-surgery[2][3]. This not only helps in managing pain more safely but also reduces the side effects that can be more severe in children.

During recovery, children may experience side effects such as nausea, vomiting, or grogginess. However, these are typically short-term and can be managed with appropriate medication. Anesthesiologists tailor the type and amount of anesthesia to each child's needs, ensuring safety and comfort before, during, and after the procedure[4]. Pain management is a joint effort between anesthesiologists, surgeons, and sometimes pain specialists, who work together to provide effective pain relief while also ensuring the child's safety and comfort[3][4]. This comprehensive care helps in ensuring that children recover well from surgery, with a lower risk of long-term effects and a faster return to normal activities.

When it comes to recovery factors that influence surgical outcomes, follow-up care and long-term management play a significant role. These elements are often considered the final but most important part of the recovery and surgical outcome management.

Follow-up care is the practice of maintaining a patient's health status post-surgery by ensuring they are recovering as they should. This includes a number of activities such as postoperative pain management, physical mobilization, and addressing any complications that may have arisen. Studies have found that patients undergoing enhanced recovery after surgery (ERAS) guidelines, which emphasize early mobilization and appropriate analgesia, have a lower risk of complications and readmission compared to traditional care[3]. This indicates that the structured follow-up care in ERAS can improve recovery and long-term outcomes.

In addition to follow-up care, long-term management is also important. Long-term care focuses on the patient's ability to return to their normal lifestyle and activities. This includes regaining independence, resolving symptoms, and overcoming mental strains[5]. For many patients, recovery is not just about the absence of complications but also about returning to their preoperative habits and routines, such as work, social interactions, and physical activities[5]. Long-term care strategies should incorporate these patient-centered goals to improve the patient's perceived recovery and well-being.



Psychosocial factors also play a significant role in recovery. Studies have found that mood and attitudinal factors are strongly predictive of surgical outcomes, even after accounting for clinical factors[1]. This indicates that long-term care should also consider psychological support and social support to help patients fully recovery from their surgery.

In practice, follow-up and long-term care should be structured to include patient-centered strategies. This includes setting recovery goals based on the patient's lifestyle and values, addressing mental health issues, and ensuring that patients have the necessary support to return to their normal routines. In this, both the surgeon and the patient play a role in ensuring that the recovery is not just about clinical parameters but also about the patient's well being and return to normal life.

When it concerns surgical outcomes, especially in the recovery process following oral surgery, several factors play a crucial role in ensuring a smooth and successful healing journey. One of the most critical elements is the necessity of follow-up appointments. These visits are essential for monitoring the recovery progress and addressing any potential complications early on. By maintaining close communication with the dental care team, parents can ensure that their child's healing process is tailored to their specific needs.

Follow-up appointments allow the surgeon to assess how well the child is healing and provide additional instructions based on their progress. This proactive approach not only ensures that any emerging issues are detected promptly but also significantly enhance the healing process by allowing for timely intervention. Furthermore, these visits provide an essential check on the child's pain levels and any unusual symptoms, allowing for appropriate management and support.

In the management of a child's recovery after oral surgery, parents can play a pivotal role by following a structured approach. Selecting the right pediatric dentist is crucial as it ensures a skilled and experienced care team that can make a significant difference in the child's overall oral health journey. A positive rapport with the dentist can contribute to a more relaxed atmosphere during the surgery and recovery process.

Post-surgery instructions provided by the pediatric dentist must be followed diligently. These instructions often include guidelines on medication, dietary restrictions, and oral care routines. Strict adherence to these recommendations is vital for a smooth and complication-free recovery. Pain management is another critical aspect, where prescribed pain medication should be used as directed, and additional measures like cold compresses can help reduce swelling and discomfort.

In maintaining good oral hygiene during recovery, parents should follow specific instructions for cleaning the surgical site using a soft-bristled toothbrush and gentle care to avoid irritation. Encourage the child to rinse their mouth with a prescribed solution to promote cleanliness and prevent infection.

It is also important for parents to be vigilant and observe their child for any signs of complications such as excessive bleeding, persistent pain, or unusual swelling. If any concerning symptoms are detected, the pediatric dentist should be promptly for guidance. Early intervention can prevent potential issues and ensure a smoother recovery.

In the long term, ensuring the child's oral health requires a proactive and supportive approach. By being attentive, supportive, and proactive in following post-surgery guidelines and maintaining good oral hygiene, parents can significantly contribute to their child's oral health and well-being. This not only ensures a successful recovery but also a positive oral health journey in the years to follow.

When it's time to recover from surgery, the process can be both complex and personal. A successful recovery is not just about the physical aspect of surgery; it also includes psychological and social factors that play a significant role in outcomes. Here are some tips for a smoother recovery, taking into account these various factors.

**Follow Instructions and Trust the Recovery process:**

The first step in ensuring a successful recovery is to follow your doctor's instructions. This includes taking prescribed medications, attending follow-up care, and understanding the recovery process. Trusting the process can help reduce the risk of complications and give you the best chance of a successful recovery.

**Psychosocial Factors:**

Psychosocial factors such as depression, social support, and mood can strongly influence recovery. Patients with a more proactive and less depressed state of being often recover more speedily and fully. Enclose yourself with a support network of family and friends who can provide both physical and mental support during this time.

**Enhanced Recovery After Surgery (ERAS) Guidelines:**

ERAS guidelines have been widely successful in improving surgical outcomes by decreasing hospital stays and complications. These guidelines often include early mobilization, postoperative analgesia considerations, and postoperative diet and bowel management. By

following these protocols, patients can experience a smoother and more successful recovery.

### **Understanding Recovery from the Patient's perspective:**

To patients, recovery is not just about clinical parameters like hospital stay duration or absence of complications. Recovery also includes returning to preoperative habits and routines, resolving symptoms, overcoming mental strains, regaining independence, and enjoying life. By understanding these perspectives, patient-centered strategies can be more tailored to improve postoperative recovery.

In the end, a successful recovery is a personal and tailored process that requires both clinical and psychosocial support. By following these tips and understanding the comprehensive meaning of recovery, patients can ensure a smoother and more successful recovery after surgery.

When it's time for a child to recover from surgery, parents play a significant role in ensuring that their child's recovery is as effective and comfortable as possible. This recovery period is not just about physical health, but also about emotional well being and the environment at play. Here are some specific tips for parents to help their child recover more effectively, including considerations for environment, diet, and activities during the recovery period.

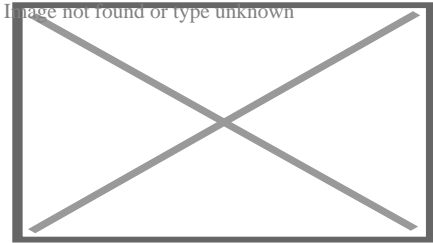
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### **About health professional**

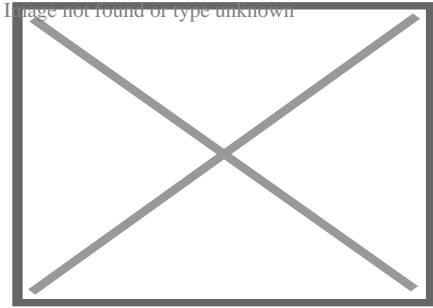
A **health professional**, **healthcare professional**, or **healthcare worker** (sometimes abbreviated **HCW**)<sup>[1]</sup> is a provider of health care treatment and advice based on formal training and experience. The field includes those who work as a nurse, physician (such as family physician, internist, obstetrician, psychiatrist, radiologist, surgeon etc.), physician assistant, registered dietitian, veterinarian, veterinary technician, optometrist, pharmacist, pharmacy technician, medical assistant, physical therapist, occupational therapist, dentist, midwife, psychologist, audiologist, or healthcare scientist, or who perform services in allied health professions. Experts in public health and community health are also health professionals.

### **Fields**

[edit]



NY College of Health Professions massage therapy class

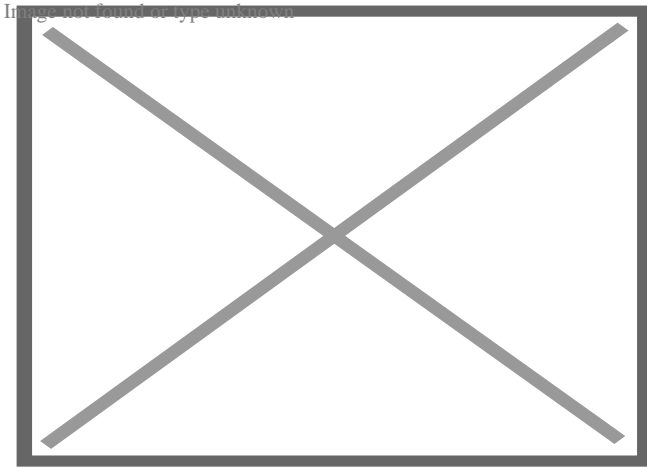


US Navy doctors deliver a healthy baby

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**Health practitioners  
and professionals**

- Athletic trainer
- Audiologist
- Chiropractor
- Clinical coder
- Clinical nurse specialist
- Clinical officer
- Community health worker
- Dentist
- Dietitian and nutritionist
- Emergency medical technician
- Feldsher
- Health administrator
- Medical assistant
- Medical laboratory scientist
- Medical transcriptionist
- Nurse anesthetist
- Nurse practitioner
- Nurse midwife
- Nurse
- Occupational Therapist
- Optometrist
- Paramedic
- Pharmacist
- Pharmaconomist
- Pharmacy technician
- Phlebotomist
- Physician
- Physician assistant
- Podiatrist
- Psychologist
- Psychotherapist
- Physical therapist
- Radiographer
- Radiotherapist
- Respiratory therapist
- Speech-language pathologist
- Social Work
- Surgeon
- Surgeon's assistant
- Surgical technologist



70% of global health and social care workers are women, 30% of leaders in the global health sector are women

The healthcare workforce comprises a wide variety of professions and occupations who provide some type of healthcare service, including such direct care practitioners as physicians, nurse practitioners, physician assistants, nurses, respiratory therapists, dentists, pharmacists, speech-language pathologist, physical therapists, occupational therapists, physical and behavior therapists, as well as allied health professionals such as phlebotomists, medical laboratory scientists, dieticians, and social workers. They often work in hospitals, healthcare centers and other service delivery points, but also in academic training, research, and administration. Some provide care and treatment services for patients in private homes. Many countries have a large number of community health workers who work outside formal healthcare institutions. Managers of healthcare services, health information technicians, and other assistive personnel and support workers are also considered a vital part of health care teams.<sup>[2]</sup>

Healthcare practitioners are commonly grouped into health professions. Within each field of expertise, practitioners are often classified according to skill level and skill specialization. "Health professionals" are highly skilled workers, in professions that usually require extensive knowledge including university-level study leading to the award of a first degree or higher qualification.<sup>[3]</sup> This category includes physicians, physician assistants, registered nurses, veterinarians, veterinary technicians, veterinary assistants, dentists, midwives, radiographers, pharmacists, physiotherapists, optometrists, operating department practitioners and others. Allied health professionals, also referred to as "health associate professionals" in the International Standard Classification of Occupations, support implementation of health care, treatment and referral plans usually established by medical, nursing, respiratory care, and other health professionals, and usually require formal qualifications to practice their profession. In addition, unlicensed assistive personnel assist with providing health care services as permitted.<sup>[citation needed]</sup>

Another way to categorize healthcare practitioners is according to the sub-field in which they practice, such as mental health care, pregnancy and childbirth care, surgical care, rehabilitation care, or public health.<sup>[citation needed]</sup>

## Mental health

[edit]

Main article: Mental health professional

A mental health professional is a health worker who offers services to improve the mental health of individuals or treat mental illness. These include psychiatrists, psychiatry physician assistants, clinical, counseling, and school psychologists, occupational therapists, clinical social workers, psychiatric-mental health nurse practitioners, marriage and family therapists, mental health counselors, as well as other health professionals and allied health professions. These health care providers often deal with the same illnesses, disorders, conditions, and issues; however, their scope of practice often differs. The most significant difference across categories of mental health practitioners is education and training.<sup>[4]</sup> There are many damaging effects to the health care workers. Many have had diverse negative psychological symptoms ranging from emotional trauma to very severe anxiety. Health care workers have not been treated right and because of that their mental, physical, and emotional health has been affected by it. The SAGE author's said that there were 94% of nurses that had experienced at least one PTSD after the traumatic experience. Others have experienced nightmares, flashbacks, and short and long term emotional reactions.<sup>[5]</sup> The abuse is causing detrimental effects on these health care workers. Violence is causing health care workers to have a negative attitude toward work tasks and patients, and because of that they are "feeling pressured to accept the order, dispense a product, or administer a medication".<sup>[6]</sup> Sometimes it can range from verbal to sexual to physical harassment, whether the abuser is a patient, patient's families, physician, supervisors, or nurses.<sup>[citation needed]</sup>

## Obstetrics

[edit]

Main articles: Obstetrics, Midwifery, and Birth attendant

A maternal and newborn health practitioner is a health care expert who deals with the care of women and their children before, during and after pregnancy and childbirth. Such health practitioners include obstetricians, physician assistants, midwives, obstetrical nurses and many others. One of the main differences between these

professions is in the training and authority to provide surgical services and other life-saving interventions.<sup>[7]</sup> In some developing countries, traditional birth attendants, or traditional midwives, are the primary source of pregnancy and childbirth care for many women and families, although they are not certified or licensed. According to research, rates for unhappiness among obstetrician-gynecologists (Ob-Gyns) range somewhere between 40 and 75 percent.<sup>[8]</sup>

## Geriatrics

[edit]

Main articles: Geriatrics and Geriatric care management

A geriatric care practitioner plans and coordinates the care of the elderly and/or disabled to promote their health, improve their quality of life, and maintain their independence for as long as possible.<sup>[9]</sup> They include geriatricians, occupational therapists, physician assistants, adult-gerontology nurse practitioners, clinical nurse specialists, geriatric clinical pharmacists, geriatric nurses, geriatric care managers, geriatric aides, nursing aides, caregivers and others who focus on the health and psychological care needs of older adults.<sup>[citation needed]</sup>

## Surgery

[edit]

A surgical practitioner is a healthcare professional and expert who specializes in the planning and delivery of a patient's perioperative care, including during the anaesthetic, surgical and recovery stages. They may include general and specialist surgeons, physician assistants, assistant surgeons, surgical assistants, veterinary surgeons, veterinary technicians, anesthesiologists, anesthesiologist assistants, nurse anesthetists, surgical nurses, clinical officers, operating department practitioners, anaesthetic technicians, perioperative nurses, surgical technologists, and others.<sup>[citation needed]</sup>

## Rehabilitation

[edit]



A rehabilitation care practitioner is a health worker who provides care and treatment which aims to enhance and restore functional ability and quality of life to those with physical impairments or disabilities. These include psychiatrists, physician assistants, rehabilitation nurses, clinical nurse specialists, nurse practitioners, physiotherapists, chiropractors, orthotists, prosthetists, occupational therapists, recreational therapists, audiologists, speech and language pathologists, respiratory therapists, rehabilitation counsellors, physical rehabilitation therapists, athletic trainers, physiotherapy technicians, orthotic technicians, prosthetic technicians, personal care assistants, and others.<sup>[10]</sup>

## Optometry

[edit]

Main article: [Optometry](#)

Optometry is a field traditionally associated with the correction of refractive errors using glasses or contact lenses, and treating eye diseases. Optometrists also provide general eye care, including screening exams for glaucoma and diabetic retinopathy and management of routine eye conditions. Optometrists may also undergo further training in order to specialize in various fields, including glaucoma, medical retina, low vision, or paediatrics. In some countries, such as the United Kingdom, United States, and Canada, Optometrists may also undergo further training in order to be able to perform some surgical procedures.

## Diagnostics

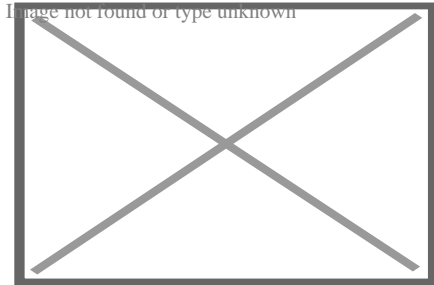
[edit]

Main article: [Medical diagnosis](#)

Medical diagnosis providers are health workers responsible for the process of determining which disease or condition explains a person's symptoms and signs. It is most often referred to as diagnosis with the medical context being implicit. This usually involves a team of healthcare providers in various diagnostic units. These include radiographers, radiologists, Sonographers, medical laboratory scientists, pathologists, and related professionals.<sup>*[citation needed]*</sup>

# Dentistry

[edit]



Dental assistant on the right supporting a dental operator on the left, during a procedure.

Main article: Dentistry

A dental care practitioner is a health worker and expert who provides care and treatment to promote and restore oral health. These include dentists and dental surgeons, dental assistants, dental auxiliaries, dental hygienists, dental nurses, dental technicians, dental therapists or oral health therapists, and related professionals.

# Podiatry

[edit]

Care and treatment for the foot, ankle, and lower leg may be delivered by podiatrists, chiropodists, pedorthists, foot health practitioners, podiatric medical assistants, podiatric nurse and others.

# Public health

[edit]

A public health practitioner focuses on improving health among individuals, families and communities through the prevention and treatment of diseases and injuries, surveillance of cases, and promotion of healthy behaviors. This category includes community and preventive medicine specialists, physician assistants, public health nurses, pharmacist,

clinical nurse specialists, dietitians, environmental health officers (public health inspectors), paramedics, epidemiologists, public health dentists, and others.<sup>[*citation needed*]</sup>

## Alternative medicine

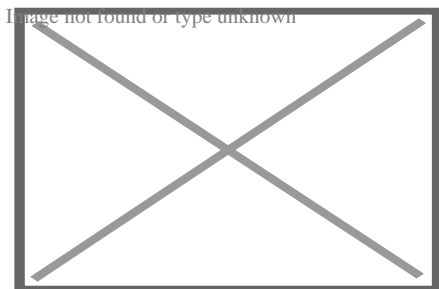
[edit]

In many societies, practitioners of alternative medicine have contact with a significant number of people, either as integrated within or remaining outside the formal health care system. These include practitioners in acupuncture, Ayurveda, herbalism, homeopathy, naturopathy, Reiki, Shamballa Reiki energy healing Archived 2021-01-25 at the Wayback Machine, Siddha medicine, traditional Chinese medicine, traditional Korean medicine, Unani, and Yoga. In some countries such as Canada, chiropractors and osteopaths (not to be confused with doctors of osteopathic medicine in the United States) are considered alternative medicine practitioners.

### Occupational hazards

[edit]

See also: Occupational hazards in dentistry and Nursing § Occupational hazards



A healthcare professional wears an air sampling device to investigate exposure to airborne influenza

A video describing the Occupational Health and Safety Network, a tool for monitoring occupational hazards to health care workers

The healthcare workforce faces unique health and safety challenges and is recognized by the National Institute for Occupational Safety and Health (NIOSH) as a priority industry sector in the National Occupational Research Agenda (NORA) to identify and provide intervention strategies regarding occupational health and safety issues.<sup>[<sup>1</sup>]</sup>

# Biological hazards

[edit]

Exposure to respiratory infectious diseases like tuberculosis (caused by *Mycobacterium tuberculosis*) and influenza can be reduced with the use of respirators; this exposure is a significant occupational hazard for health care professionals.<sup>[12]</sup> Healthcare workers are also at risk for diseases that are contracted through extended contact with a patient, including scabies.<sup>[13]</sup> Health professionals are also at risk for contracting blood-borne diseases like hepatitis B, hepatitis C, and HIV/AIDS through needlestick injuries or contact with bodily fluids.<sup>[14]</sup><sup>[15]</sup> This risk can be mitigated with vaccination when there is a vaccine available, like with hepatitis B.<sup>[15]</sup> In epidemic situations, such as the 2014-2016 West African Ebola virus epidemic or the 2003 SARS outbreak, healthcare workers are at even greater risk, and were disproportionately affected in both the Ebola and SARS outbreaks.<sup>[16]</sup>

In general, appropriate personal protective equipment (PPE) is the first-line mode of protection for healthcare workers from infectious diseases. For it to be effective against highly contagious diseases, personal protective equipment must be watertight and prevent the skin and mucous membranes from contacting infectious material. Different levels of personal protective equipment created to unique standards are used in situations where the risk of infection is different. Practices such as triple gloving and multiple respirators do not provide a higher level of protection and present a burden to the worker, who is additionally at increased risk of exposure when removing the PPE. Compliance with appropriate personal protective equipment rules may be difficult in certain situations, such as tropical environments or low-resource settings. A 2020 Cochrane systematic review found low-quality evidence that using more breathable fabric in PPE, double gloving, and active training reduce the risk of contamination but that more randomized controlled trials are needed for how best to train healthcare workers in proper PPE use.<sup>[16]</sup>

## Tuberculosis screening, testing, and education

[edit]

Based on recommendations from The United States Center for Disease Control and Prevention (CDC) for TB screening and testing the following best practices should be followed when hiring and employing Health Care Personnel.<sup>[17]</sup>

When hiring Health Care Personnel, the applicant should complete the following:<sup>[18]</sup> a TB risk assessment,<sup>[19]</sup> a TB symptom evaluation for at least those listed on the Signs & Symptoms page,<sup>[20]</sup> a TB test in accordance with the guidelines for Testing for TB Infection,<sup>[21]</sup> and additional evaluation for TB disease as needed (e.g. chest x-ray for HCP with a positive TB test)<sup>[18]</sup> The CDC recommends either a blood test, also known as an interferon-gamma release assay (IGRA), or a skin test, also known as a Mantoux tuberculin skin test (TST).<sup>[21]</sup> A TB blood test for baseline testing does not require two-step testing. If the skin test method is used to test HCP upon hire, then two-step testing should be used. A one-step test is not recommended.<sup>[18]</sup>

The CDC has outlined further specifics on recommended testing for several scenarios.<sup>[22]</sup> In summary:

1. Previous documented positive skin test (TST) then a further TST is not recommended
2. Previous documented negative TST within 12 months before employment OR at least two documented negative TSTs ever then a single TST is recommended
3. All other scenarios, with the exception of programs using blood tests, the recommended testing is a two-step TST

According to these recommended testing guidelines any two negative TST results within 12 months of each other constitute a two-step TST.

For annual screening, testing, and education, the only recurring requirement for all HCP is to receive TB education annually.<sup>[18]</sup> While the CDC offers education materials, there is not a well defined requirement as to what constitutes a satisfactory annual education. Annual TB testing is no longer recommended unless there is a known exposure or ongoing transmission at a healthcare facility. Should an HCP be considered at increased occupational risk for TB annual screening may be considered. For HCP with a documented history of a positive TB test result do not need to be re-tested but should instead complete a TB symptom evaluation. It is assumed that any HCP who has undergone a chest x-ray test has had a previous positive test result. When considering mental health you may see your doctor to be evaluated at your digression. It is recommended to see someone at least once a year in order to make sure that there has not been any sudden changes.<sup>[23]</sup>

## Psychosocial hazards

[edit]

Occupational stress and occupational burnout are highly prevalent among health professionals.<sup>[24]</sup> Some studies suggest that workplace stress is pervasive in the health

care industry because of inadequate staffing levels, long work hours, exposure to infectious diseases and hazardous substances leading to illness or death, and in some countries threat of malpractice litigation. Other stressors include the emotional labor of caring for ill people and high patient loads. The consequences of this stress can include substance abuse, suicide, major depressive disorder, and anxiety, all of which occur at higher rates in health professionals than the general working population. Elevated levels of stress are also linked to high rates of burnout, absenteeism and diagnostic errors, and reduced rates of patient satisfaction.<sup>[25]</sup> In Canada, a national report (*Canada's Health Care Providers*) also indicated higher rates of absenteeism due to illness or disability among health care workers compared to the rest of the working population, although those working in health care reported similar levels of good health and fewer reports of being injured at work.<sup>[26]</sup>

There is some evidence that cognitive-behavioral therapy, relaxation training and therapy (including meditation and massage), and modifying schedules can reduce stress and burnout among multiple sectors of health care providers. Research is ongoing in this area, especially with regards to physicians, whose occupational stress and burnout is less researched compared to other health professions.<sup>[27]</sup>

Healthcare workers are at higher risk of on-the-job injury due to violence. Drunk, confused, and hostile patients and visitors are a continual threat to providers attempting to treat patients. Frequently, assault and violence in a healthcare setting goes unreported and is wrongly assumed to be part of the job.<sup>[28]</sup> Violent incidents typically occur during one-on-one care; being alone with patients increases healthcare workers' risk of assault.<sup>[29]</sup> In the United States, healthcare workers experience 2/3 of nonfatal workplace violence incidents.<sup>[28]</sup> Psychiatric units represent the highest proportion of violent incidents, at 40%; they are followed by geriatric units (20%) and the emergency department (10%). Workplace violence can also cause psychological trauma.<sup>[29]</sup>

Health care professionals are also likely to experience sleep deprivation due to their jobs. Many health care professionals are on a shift work schedule, and therefore experience misalignment of their work schedule and their circadian rhythm. In 2007, 32% of healthcare workers were found to get fewer than 6 hours of sleep a night. Sleep deprivation also predisposes healthcare professionals to make mistakes that may potentially endanger a patient.<sup>[30]</sup>

## **COVID pandemic**

[edit]

Especially in times like the present (2020), the hazards of health professional stem into the mental health. Research from the last few months highlights that COVID-19 has contributed greatly to the degradation of mental health in healthcare providers. This

includes, but is not limited to, anxiety, depression/burnout, and insomnia. [citation needed]

A study done by Di Mattei et al. (2020) revealed that 12.63% of COVID nurses and 16.28% of other COVID healthcare workers reported extremely severe anxiety symptoms at the peak of the pandemic.[<sup>31</sup>] In addition, another study was conducted on 1,448 full time employees in Japan. The participants were surveyed at baseline in March 2020 and then again in May 2020. The result of the study showed that psychological distress and anxiety had increased more among healthcare workers during the COVID-19 outbreak.[<sup>32</sup>]

Similarly, studies have also shown that following the pandemic, at least one in five healthcare professionals report symptoms of anxiety.[<sup>33</sup>] Specifically, the aspect of "anxiety was assessed in 12 studies, with a pooled prevalence of 23.2%" following COVID.[<sup>33</sup>] When considering all 1,448 participants that percentage makes up about 335 people.

## Abuse by patients

[edit]

- The patients are selecting victims who are more vulnerable. For example, Cho said that these would be the nurses that are lacking experience or trying to get used to their new roles at work.[<sup>34</sup>]
- Others authors that agree with this are Vento, Cainelli, & Vallone and they said that, the reason patients have caused danger to health care workers is because of insufficient communication between them, long waiting lines, and overcrowding in waiting areas.[<sup>35</sup>] When patients are intrusive and/or violent toward the faculty, this makes the staff question what they should do about taking care of a patient.
- There have been many incidents from patients that have really caused some health care workers to be traumatized and have so much self doubt. Goldblatt and other authors said that there was a lady who was giving birth, her husband said, "Who is in charge around here"? "Who are these sluts you employ here".[<sup>5</sup>] This was very avoidable to have been said to the people who are taking care of your wife and child.

## Physical and chemical hazards

[edit]

Slips, trips, and falls are the second-most common cause of worker's compensation claims in the US and cause 21% of work absences due to injury. These injuries most commonly result in strains and sprains; women, those older than 45, and those who

have been working less than a year in a healthcare setting are at the highest risk.[<sup>36</sup>]

An epidemiological study published in 2018 examined the hearing status of noise-exposed health care and social assistance (HSA) workers sector to estimate and compare the prevalence of hearing loss by subsector within the sector. Most of the HSA subsector prevalence estimates ranged from 14% to 18%, but the Medical and Diagnostic Laboratories subsector had 31% prevalence and the Offices of All Other Miscellaneous Health Practitioners had a 24% prevalence. The Child Day Care Services subsector also had a 52% higher risk than the reference industry.[<sup>37</sup>]

Exposure to hazardous drugs, including those for chemotherapy, is another potential occupational risk. These drugs can cause cancer and other health conditions.[<sup>38</sup>]

## Gender factors

[edit]

Female health care workers may face specific types of workplace-related health conditions and stress. According to the World Health Organization, women predominate in the formal health workforce in many countries and are prone to musculoskeletal injury (caused by physically demanding job tasks such as lifting and moving patients) and burnout. Female health workers are exposed to hazardous drugs and chemicals in the workplace which may cause adverse reproductive outcomes such as spontaneous abortion and congenital malformations. In some contexts, female health workers are also subject to gender-based violence from coworkers and patients.[<sup>39</sup>][<sup>40</sup>]

## Workforce shortages

[edit]

See also: Health workforce, Doctor shortage, and Nursing shortage

Many jurisdictions report shortfalls in the number of trained health human resources to meet population health needs and/or service delivery targets, especially in medically underserved areas. For example, in the United States, the 2010 federal budget invested \$330 million to increase the number of physicians, physician assistants, nurse practitioners, nurses, and dentists practicing in areas of the country experiencing shortages of trained health professionals. The Budget expands loan repayment programs for physicians, nurses, and dentists who agree to practice in medically underserved areas. This funding will enhance the capacity of nursing schools to



increase the number of nurses. It will also allow states to increase access to oral health care through dental workforce development grants. The Budget's new resources will sustain the expansion of the health care workforce funded in the Recovery Act.<sup>[41]</sup> There were 15.7 million health care professionals in the US as of 2011.<sup>[36]</sup>

In Canada, the 2011 federal budget announced a Canada Student Loan forgiveness program to encourage and support new family physicians, physician assistants, nurse practitioners and nurses to practice in underserved rural or remote communities of the country, including communities that provide health services to First Nations and Inuit populations.<sup>[42]</sup>

In Uganda, the Ministry of Health reports that as many as 50% of staffing positions for health workers in rural and underserved areas remain vacant. As of early 2011, the Ministry was conducting research and costing analyses to determine the most appropriate attraction and retention packages for medical officers, nursing officers, pharmacists, and laboratory technicians in the country's rural areas.<sup>[43]</sup>

At the international level, the World Health Organization estimates a shortage of almost 4.3 million doctors, midwives, nurses, and support workers worldwide to meet target coverage levels of essential primary health care interventions.<sup>[44]</sup> The shortage is reported most severe in 57 of the poorest countries, especially in sub-Saharan Africa.

Nurses are the most common type of medical field worker to face shortages around the world. There are numerous reasons that the nursing shortage occurs globally. Some include: inadequate pay, a large percentage of working nurses are over the age of 45 and are nearing retirement age, burnout, and lack of recognition.<sup>[45]</sup>

Incentive programs have been put in place to aid in the deficit of pharmacists and pharmacy students. The reason for the shortage of pharmacy students is unknown but one can infer that it is due to the level of difficulty in the program.<sup>[46]</sup>

Results of nursing staff shortages can cause unsafe staffing levels that lead to poor patient care. Five or more incidents that occur per day in a hospital setting as a result of nurses who do not receive adequate rest or meal breaks is a common issue.<sup>[47]</sup>

## **Regulation and registration**

[edit]

Main article: Health professional requisites

Practicing without a license that is valid and current is typically illegal. In most jurisdictions, the provision of health care services is regulated by the government. Individuals found to be providing medical, nursing or other professional services without the appropriate certification or license may face sanctions and criminal charges leading

to a prison term. The number of professions subject to regulation, requisites for individuals to receive professional licensure, and nature of sanctions that can be imposed for failure to comply vary across jurisdictions.

In the United States, under Michigan state laws, an individual is guilty of a felony if identified as practicing in the health profession without a valid personal license or registration. Health professionals can also be imprisoned if found guilty of practicing beyond the limits allowed by their licenses and registration. The state laws define the scope of practice for medicine, nursing, and a number of allied health professions.<sup>[48]</sup><sup>[unreliable]</sup> In Florida, practicing medicine without the appropriate license is a crime classified as a third degree felony,<sup>[49]</sup> which may give imprisonment up to five years. Practicing a health care profession without a license which results in serious bodily injury classifies as a second degree felony,<sup>[49]</sup> providing up to 15 years' imprisonment.

In the United Kingdom, healthcare professionals are regulated by the state; the UK Health and Care Professions Council (HCPC) protects the 'title' of each profession it regulates. For example, it is illegal for someone to call himself an Occupational Therapist or Radiographer if they are not on the register held by the HCPC.

## See also

[edit]

- List of healthcare occupations
- Community health center
- Chronic care management
- Electronic superbill
- Geriatric care management
- Health human resources
- Uniform Emergency Volunteer Health Practitioners Act

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## External links

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- Pharmacy
- Healthcare science
- Dentistry
- Allied health professions
- Health information management
- Assisted living

**Settings**

- Clinic
- Hospital
- Nursing home
- Medical school (Academic health science centre, Teaching hospital)
- Pharmacy school
- Supervised injection site
- Acute
- Chronic
- End-of-life
- Hospice

**Care**

- Overutilization
- Palliative
- Primary
- Self
- Total

**Skills /  
training**

- Bedside manner
- Cultural competence
- Diagnosis
- Education
- Universal precautions

## Technology

- 3D bioprinting
- Artificial intelligence
- Connected health
- Digital health
- Electronic health records
- mHealth
- Nanomedicine
- Telemedicine
- Medical image computing and imaging informatics
- Artificial intelligence in healthcare
- Neuroinformatics in healthcare
- Behavior informatics in healthcare
- Computational biology in healthcare

## Health informatics

- Translational bioinformatics
- Translational medicine
- health information technology
- Telemedicine
- Public health informatics
- Health information management
- Consumer health informatics
- United States
  - reform debate in the United States
  - History of public health in the United States

## By country

- United Kingdom
- Canada
- Australia
- New Zealand
- (Category Health care by country)

-  Category

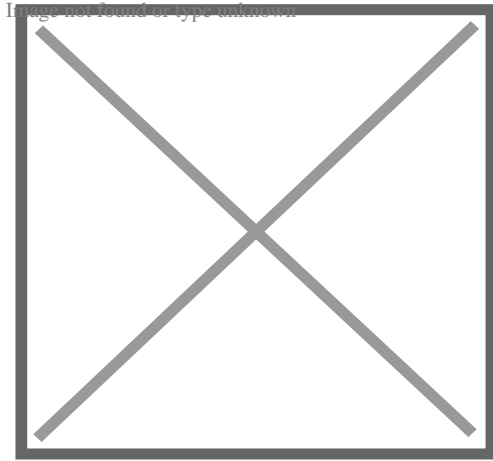
**Authority control databases:** National  Czech Republic  [Edit this at Wikidata](#)

## About tooth

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



## Tooth



A chimpanzee displaying his teeth

### Details

### Identifiers

<b>Latin</b>	<i>dens</i>
<b>MeSH</b>	D014070
<b>FMA</b>	12516

Anatomical terminology

[edit on Wikidata]

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 crocodylians. 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.<sup>[1]</sup>

**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.<sup>[2][3]</sup> Also, tusks (in tusked mammals) grow almost throughout life.<sup>[4]</sup>

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.<sup>[1]</sup> 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.<sup>[5][6]</sup>

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.<sup>[1]</sup>

## Etymology

[edit]

The word *tooth* comes from Proto-Germanic *\*tanþs*, derived from the Proto-Indo-European *\*h<sub>2</sub>dent-* which was composed of the root *\*h<sub>2</sub>ed-* 'to eat' plus the active participle suffix *\*-nt-*, therefore literally meaning 'that which eats'.<sup>[7]</sup>

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 *\*t<sup>ē</sup>iz* via unrelated phonological processes) was raised to */e<sup>ī</sup>/*, and later unrounded to */e<sup>ē</sup>/*, resulting in the *t<sup>ē</sup>iz* / *t<sup>ē</sup>iz* / *t<sup>ē</sup>iz* alternation attested from Old English. Cf. also Old English *b<sup>ō</sup>c* / *b<sup>œ</sup>c* 'book/books' and *m<sup>ūs</sup>* / *m<sup>īs</sup>* 'mouse/mice', from Proto-Germanic *\*b<sup>ō</sup>ks* / *b<sup>œ</sup>kiz* and *\*m<sup>ūs</sup>* / *m<sup>īs</sup>*.

respectively.

Cognate with Latin *dācœns*, Greek *ἰσχυρός* (*iodous*), and Sanskrit *dāt*.

## Origin

[edit]

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).<sup>[4][8]</sup>

The genes governing tooth development in mammals are homologous to those involved in the development of fish scales.<sup>[9]</sup> 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.<sup>[10]</sup>

## 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

[edit]

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

# Canines

[edit]

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.<sup>[12]</sup> Sometimes called cuspids, these teeth are shaped like points (cusps) and are used for tearing and grasping food.<sup>[13]</sup>

# 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.<sup>[14]</sup>

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.<sup>[15]</sup>

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.<sup>[16]</sup> All horses have 12 premolars, 12 molars, and 12 incisors.<sup>[17]</sup> 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.<sup>[18]</sup> 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.<sup>[17]</sup>

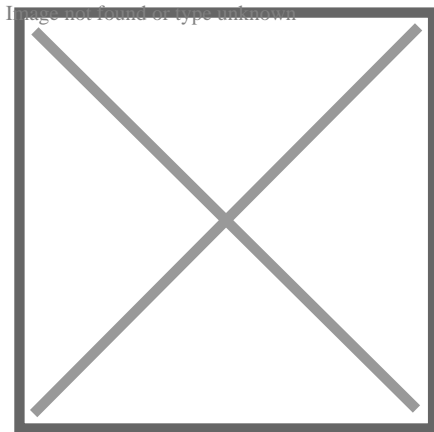
Horse teeth can be used to estimate the animal's age. Between birth and five years, age can be closely estimated by observing the eruption pattern on milk teeth and then permanent teeth. By age five, all permanent teeth have usually erupted. The horse is then said to have a "full" mouth. After the age 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

[edit]



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

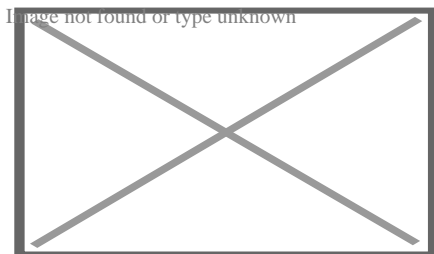
40 years of age, and will often last for an additional 20 years. When the last of these teeth has fallen out, regardless of the elephant's age, the animal will no longer be able to chew food and will die of starvation.<sup>[19][20]</sup>

## Rabbit

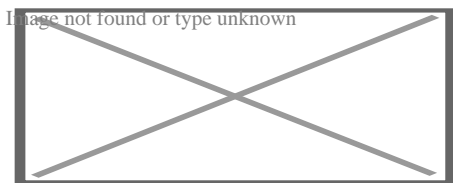
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Rabbits and other lagomorphs usually shed their deciduous teeth before (or very shortly after) their birth, and are usually born with their permanent teeth.<sup>[21]</sup> The teeth of rabbits complement their diet, which consists of a wide range of vegetation. Since many of the foods are abrasive enough to cause attrition, rabbit teeth grow continuously throughout life.<sup>[22]</sup> 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.<sup>[23]</sup>

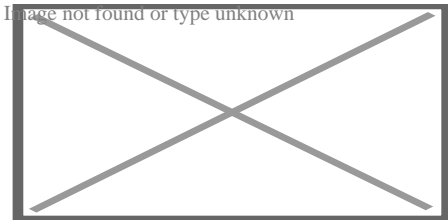
The incisors and cheek teeth of rabbits are called aradicular hypsodont teeth. This is sometimes referred to as an elodont dentition. These teeth grow or erupt continuously. The growth or eruption is held in balance by dental abrasion from chewing a diet high in fiber.



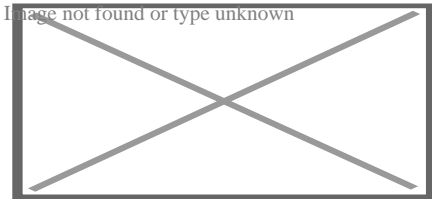
Buccal view of top incisor from *Rattus rattus*. Top incisor outlined in yellow. Molars circled in blue.



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*



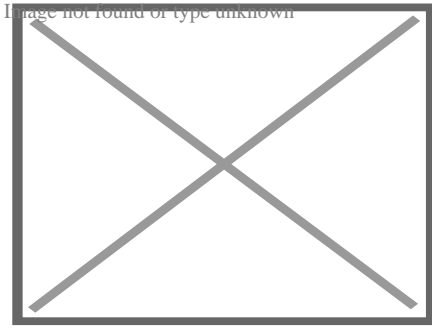
Midsagittal view of top incisor from *Rattus rattus*. Top incisor outlined in yellow. Molars circled in blue.

## Rodents

[edit]

Rodents have upper and lower hypselodont incisors that can continuously grow enamel throughout its life without having properly formed roots.<sup>[24]</sup> 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.<sup>[25]</sup> 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.<sup>[26]</sup> 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.<sup>[24]</sup> 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).<sup>[27]</sup> It usually involves the differential regulation of the epithelial stem cell niche in the tooth of two rodent species, such as guinea pigs.<sup>[28]</sup><sup>[29]</sup>





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.<sup>[28][29]</sup> 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

[edit]

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

## Walrus

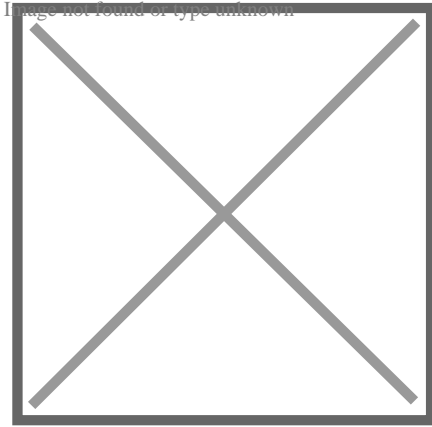
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Main article: Walrus ivory

Walrus tusks are canine teeth that grow continuously throughout life.<sup>[32]</sup>

## Fish

[edit]



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,<sup>[33]</sup><sup>[34]</sup> the majority of stem chondrichthyan lineages retained all tooth generations developed throughout the life of the animal.<sup>[35]</sup> This replacement mechanism is exemplified by the tooth whorl-based dentitions of acanthodians,<sup>[36]</sup> which include the oldest known toothed vertebrate, *Qianodus duplicis*<sup>[37]</sup>.

## Amphibians

[edit]

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.<sup>[38]</sup>

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.<sup>[39]</sup> 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.<sup>[40]</sup>

## Reptiles

[edit]

The teeth of reptiles are replaced constantly throughout their lives. Crocodylian 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, crocodylians may use 3,000 teeth from birth to death. New teeth are created within old teeth.<sup>[41]</sup>

## Birds

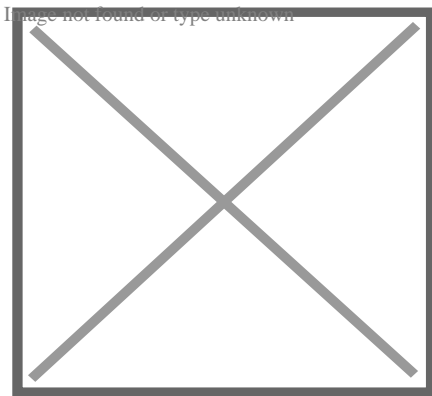
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Main article: Ichthyornis

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.<sup>[42]</sup><sup>[43]</sup>

## Invertebrates

[edit]



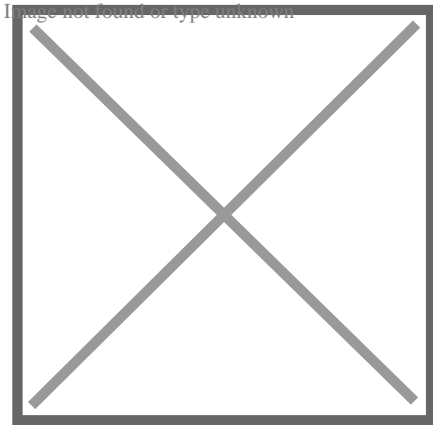
The European medicinal leech has three jaws with numerous sharp teeth which function like little saws for incising a host.

True teeth are unique to vertebrates,<sup>[44]</sup> 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.<sup>[45]</sup> 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.<sup>[46]</sup>

Historically, the European medicinal leech, another invertebrate parasite, has been used in medicine to remove blood from patients.<sup>[47]</sup> 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.<sup>[50]</sup> These teeth have the strongest known tensile strength of any biological material, outperforming spider silk.<sup>[50]</sup> 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.<sup>[51]</sup>

## Fossilization and taphonomy

[edit]


Because teeth are very resistant, often preserved when bones are not,<sup>[52]</sup> and reflect the diet of the host organism, they are very valuable to archaeologists and palaeontologists.<sup>[53]</sup> 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.<sup>[54]</sup> Dentine can be as hard as the rest of teeth and is composed of collagen fibres, reinforced with hydroxyapatite.<sup>[54]</sup>

Though teeth are very resistant, they also can be brittle and highly susceptible to cracking.<sup>[55]</sup> 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.<sup>[56]</sup> Enamel is quickly decalcified in acids,<sup>[57]</sup> perhaps by dissolution by plant acids or via diagenetic solutions, or in the stomachs of vertebrate predators.<sup>[56]</sup> Enamel can be lost by abrasion or spalling,<sup>[56]</sup> and is lost before dentine or bone are destroyed by the fossilisation process.<sup>[57]</sup> In such a case, the 'skeleton' of the teeth would consist of the dentine, with a hollow pulp cavity.<sup>[56]</sup> The organic part of dentine, conversely, is destroyed by alkalis.<sup>[57]</sup>

## See also

[edit]

-  [Medicine portal](#) known
- [Animal tooth development](#)
- [Dragon's teeth \(mythology\)](#)

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[edit]

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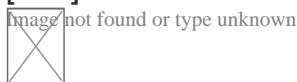
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