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## Imperative of nutritional considerations in facilitating surgical recovery ensuing oral and maxillofacial surgery

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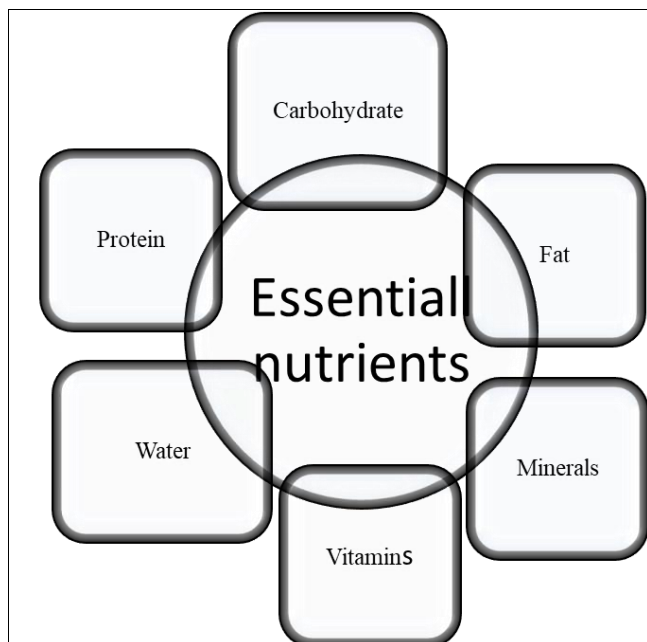
### Abstract

Oral and maxillofacial surgery often involves significant tissue trauma, which requires careful management to ensure optimal healing. Nutrition plays a critical role in modulating the body's healing processes by influencing inflammation and immune function. Adequate nutritional support can minimize postoperative complications, enhance recovery, and improve surgical outcomes. The relationship between diet, nutrition, and dental health is particularly important in the context of oral and maxillofacial surgery, as oral diseases-whether congenital, infectious, traumatic, or neoplastic-can impair the ability to eat and drink, exacerbating nutritional deficiencies. Moreover, oral surgeries, which directly affect the mouth-the body's primary route for nutrition-pose unique challenges, including heightened risks for infections and compromised healing due to the oral cavity's vulnerability. Malnutrition in these patients increases the risk of complications such as delayed healing, and can lead to higher morbidity and mortality rates. Vulnerable populations, including the elderly and immunocompromised, face even greater risks and may require specialized nutritional support through enteral, parenteral, or oral feeding methods. This review highlights the importance of preoperative, perioperative, and postoperative nutritional management to optimize healing, reduce inflammation, enhance immune function, and improve surgical outcomes. Recommendations for effective dietary management are also provided.

**Keywords:** Nutrition, wound healing, malnutrition, oral nutrition supplements, oral nutritional assessment, postoperative morbidity, surgical recovery

### Introduction

Nutrition is the study of how the body utilizes food to meet its needs for growth repair, maintenance, and development <sup>[1]</sup>. Improving surgical outcomes hinges on a patient's ability to recover without complications such as infection, wound dehiscence, or inadequate tissue regeneration <sup>[2]</sup>. Malnutrition is a significant risk factor for increased postoperative mortality, longer hospital stays, higher healthcare costs, and other complications, making it crucial to optimize nutritional status before surgery <sup>[3]</sup>. While it may be assumed that poor nutrition is primarily a concern for patients undergoing urgent or emergency surgeries, studies indicate that up to 25% of patients undergoing outpatient plastic surgery may also be at risk for malnutrition <sup>[4]</sup>. Moreover, inadequate nutrition can weaken the immune system and impair the body's ability to cope with the stress of surgery, leaving patients more vulnerable to postoperative complications like infections <sup>[5]</sup>. It is widely accepted that a well-nourished and nutritionally optimized patient is ideal when preparing for surgery. Both underweight and obese patients face heightened risks for infection and other adverse outcomes, emphasizing the need for careful nutritional management <sup>[6]</sup>. There are six essential classes of nutrients in food: carbohydrates, fats, proteins, vitamins, minerals, and water (Figure 1). Among these, carbohydrates, fats, and proteins are the primary energy producing nutrients, providing calories that the body uses for energy. Although vitamins, minerals, and water do not supply calories, they are essential for many critical bodily functions (Figure 2) <sup>[7]</sup>. Proper wound healing relies on maintaining adequate nutrition, with protein being particularly essential for cellular growth and tissue repair, especially in the case of bone healing during maxillofacial surgeries <sup>[8]</sup>.



**Fig 1:** Six essential nutrients in food



**Courtesy:** <https://www.delightmedical.com/wellness-guide/the-basics-of-healthy-eating/essential-components-of-a-healthy-diet>

**Fig 2:** The food pyramid

Patients who are malnourished face an increased risk of delayed wound healing, poor wound contraction, and heightened vulnerability to infection, all of which can prolong rehabilitation<sup>[9]</sup>. Dentists should evaluate a patient's baseline nutritional status and consider how dental procedures, along with any existing health conditions or surgical interventions, might affect their ability to maintain proper nutrition<sup>[10]</sup>. For example treatments for head and neck cancer such as surgery, chemotherapy and radiation can greatly interfere with normal eating habits making the patient's nutritional needs more complex<sup>[11]</sup>. This is a crucial consideration to ensure that the patient's nutritional requirements are met throughout treatment and recovery<sup>[12]</sup>. Surgical removal of oro-facial structures can severely impair a patient's ability to consume food, while chemotherapy and radiation often lead to long-term side effects like oral mucositis, dysgeusia, and xerostomia. These conditions can greatly hinder the patient's

ability to consume adequate nutrition<sup>[13]</sup>. Malnutrition is a significant factor in postoperative complications, as it impairs the body's ability to heal effectively<sup>[14]</sup>. Surgery induces controlled tissue damage, which can slow the recovery process, and proper nutrition is essential for tissue repair and regeneration<sup>[15]</sup>. Since the mouth is the primary entry point for food, any conditions or surgeries affecting the oral and maxillofacial areas can disrupt a patient's ability to eat both before and after surgery. The degree of difficulty will depend on the severity of the condition and the type of surgery performed. This review underscores the critical role of nutritional considerations in promoting effective recovery and optimizing outcomes following oral and maxillofacial surgery<sup>[16]</sup>.

### Discussion

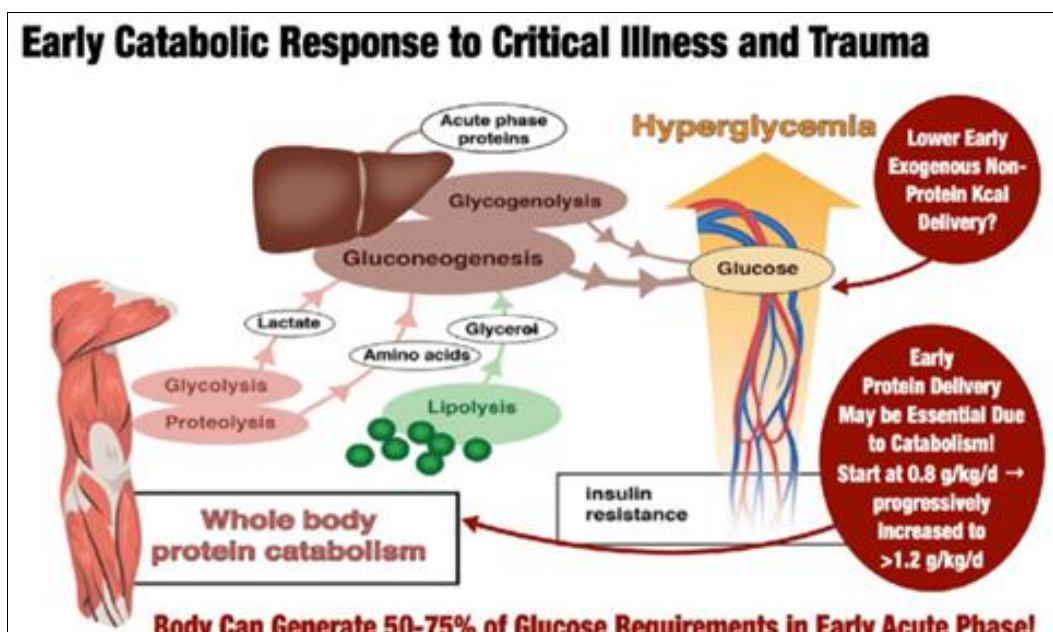
Protein is crucial for tissue repair, immune function, and overall recovery following dental surgery. Increased protein demands post-surgery support wound healing, collagen synthesis, and the restoration of muscle mass lost due to trauma or inactivity. Thus, ensuring sufficient protein intake is vital for optimal recovery and healing. For patients undergoing surgery, adequate protein and energy intake is essential for supporting the healing process, as both nutrition and wound healing are closely linked<sup>[17]</sup>. Proper nutrition provides the essential building blocks like amino acids and key nutrients that are vital for tissue repair, immune function, and collagen formation. These are histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine (Figure 3)<sup>[18]</sup>. Post-surgery, the body's increased protein requirements support tissue repair and muscle preservation. While nonessential amino acids can be synthesized, essential amino acids must come from the diet<sup>[19]</sup>. Amino acid supplements can help reduce muscle catabolism and maintain muscle strength after surgery, especially since post-surgical diets are often high in carbohydrates and low in protein (Figure 4). It's crucial to incorporate protein-rich foods e.g., meat, tofu into soft diets to prevent protein deficiency, which can delay healing and increase the risk of complications such as wound dehiscence and infection. Inadequate protein and energy intake impair recovery, making it vital to ensure proper nutrition for optimal healing<sup>[20]</sup>.

Energy from carbohydrates and fats is also necessary to fuel the body's healing processes. When energy intake is inadequate, the body may begin breaking down its own protein stores to meet its energy demands, which can delay healing<sup>[21]</sup>. Therefore, a well-balanced diet that provides sufficient protein, carbohydrates, and fats is crucial for supporting proper wound healing after surgery. Carbohydrates, proteins, and fats are the body's primary energy sources<sup>[22]</sup>. Carbohydrates are particularly important because they help prevent the body from using protein and fat for energy. However, elevated blood sugar levels or hyperglycemia can be harmful, as they suppress immune function, lead to dehydration, and can cause metabolic acidosis<sup>[23]</sup>. Carbohydrates are a key energy source for cellular processes and tissue regeneration, but patients recovering from trauma or surgery often experience insulin resistance, leading to greater reliance on protein breakdown for energy<sup>[24]</sup>. Early post-surgery replenishment of glycogen stores is crucial for immune function and reducing muscle protein breakdown<sup>[25]</sup>.

Essential	Non-Essential
Histidine	Alanine
Isoleucine	Arginine
Leucine	Asparagine
Lysine	Aspartic acid
Methionine	Cysteine
Phenylalanine	Glutamic acid
Threonine	Glutamine
Tryptophan	Glycine
Valine	Proline
	Selenocysteine
	Serine
	Tyrosine

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Fig 3: List of essential and non-essential amino acids



Courtesy: Preiser JC, Arabi Y, Berger MM, Casaer MP, McClave S, Montejo-González JC, Peake SL, Reintam Blaser A, Van den Berghe G, Van Zanten ARH, Wernerman J, Wischmeyer PE. A guide to enteral nutrition in intensive care units: 10 expert tips for the daily practice. Crit Care. 2021; 25(1):1.

Fig 3: Impact of surgery on protein requirements

Essential fatty acids are vital for maintaining cell membrane integrity and supporting immune function [26]. Omega-3 fatty acids, found in foods like fish oil and flaxseeds, are particularly important for reducing inflammation [27]. While omega-6 fatty acids are also essential, they need to be balanced with omega-3 fatty acids to prevent excessive inflammation, particularly in the context of postoperative recovery [28]. Vitamins and minerals also play key roles in wound healing and immune support [29]. Vitamin C is essential for collagen synthesis, and its deficiency can impair healing, increasing the risk of complications like wound

dehiscence [30]. Vitamin A supports immune function, epithelial regeneration, and collagen formation. A deficiency can weaken the immune response, increase infection risk, and delay healing [31]. Zinc is involved in cell division, protein synthesis, and immune function. A deficiency can delay wound healing and heighten infection susceptibility [32]. Iron is critical for oxygen transport and tissue repair; iron deficiency can lead to anemia, hindering recovery and contributing to fatigue [33]. Adequate hydration is also essential for maintaining cellular homeostasis, supporting nutrient absorption, and reducing the risk of postoperative



complications several other nutrients are also important for patients undergoing oral and maxillofacial surgery [34]. Two key nutrients are vitamin D and calcium, both of which are vital for bone health and metabolism [35]. Vitamin D deficiency is common in the general population and is often undiagnosed, so evaluating serum 25-(OH)-D levels in all presurgical patients may be worthwhile [36]. Orthopedic literature demonstrates poor surgical outcomes in patients with vitamin D deficiency, although data on whether supplementation improves outcomes is conflicting [37]. Unfortunately, studies on vitamin D supplementation in oral and maxillofacial surgery are scarce, with only limited information available on its effects on dental implant

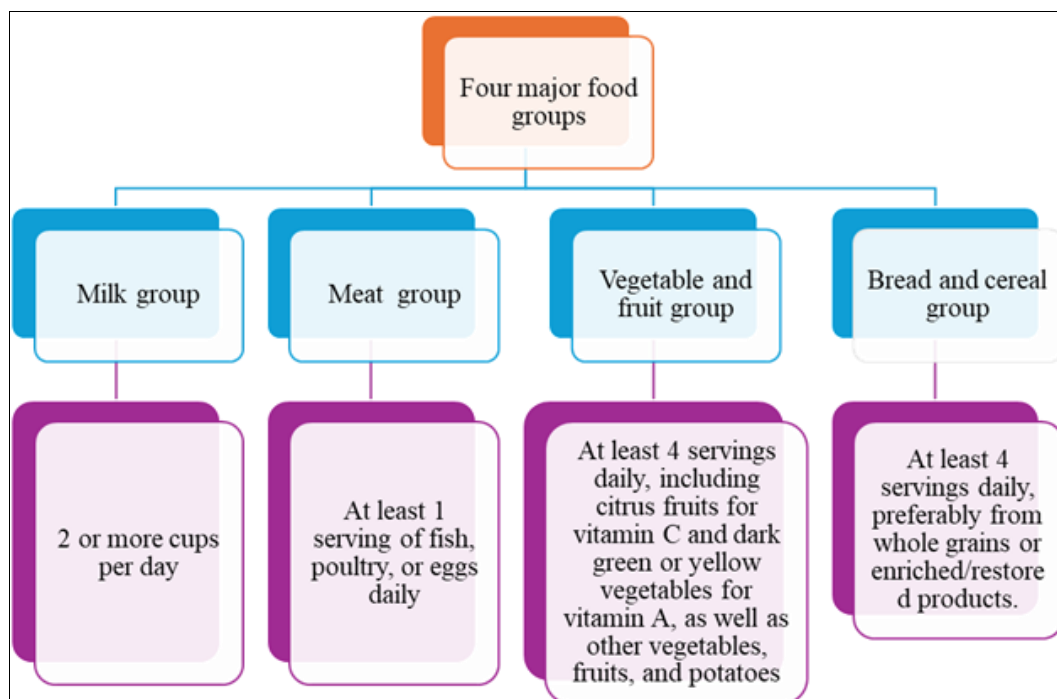
osseointegration and bone grafting, which may show slight improvements with supplementation [38]. Since serum 25(OH) D levels below 50 nmol/L are recommended for supplementation, further research in this area should be a priority. Given the wealth of literature on the importance of protein and vitamin D, it is logical to assume that proper nutrition can positively affect surgical outcomes [39]. Dehydration can lead to issues such as renal failure, reduced tissue perfusion, and increased infection risk [40]. Table 1 organizes the essential nutrients and their role in post-surgical recovery, emphasizing the importance of a balanced diet in optimizing healing and minimizing complications [41-48].

**Table 1:** Essential nutrients for post-surgical recovery

Nutrient	Role in Recovery	Consequences of Deficiency
Protein	Supports tissue repair, collagen synthesis, immune function, and muscle mass restoration	Delayed wound healing, Increased risk of complications (wound dehiscence, infection)
Essential Amino Acids	Required for protein synthesis and tissue repair (e.g., histidine, leucine, valine, etc.)	Impaired healing, weak immune function, and delayed recovery
Fats (Omega-3, Omega-6)	Essential for cell membrane integrity, inflammation regulation, and immune function	Impaired cell function, increased inflammation, delayed healing
Vitamin C	Crucial for collagen synthesis and wound healing	Impaired collagen formation, increased risk of wound dehiscence and infection
Vitamin D	Vital for bone health, metabolism, and surgical outcomes	Vitamin D deficiency is common and often undiagnosed, affecting surgical outcomes
Calcium	Supports bone health, particularly in bone healing and metabolism	Calcium works synergistically with vitamin D for optimal bone health
Vitamin A	Supports immune function, epithelial regeneration, and collagen formation	Weakened immune response, delayed healing, increased risk of infection
Zinc	Involved in protein synthesis, cell division, and immune function	Delayed wound healing, impaired immune response, increased infection risk
Iron	Critical for oxygen transport and tissue repair	Iron deficiency can lead to anemia, hindering recovery and contributing to fatigue
Hydration	Maintains cellular function, supports nutrient absorption, and reduces the risk of complications	Dehydration, renal failure, reduced tissue perfusion, increased infection risk

For optimal recovery, patients undergoing surgery require a diet that includes sufficient protein, essential vitamins and minerals, and adequate calories from carbohydrates and fats. A balanced approach, incorporating the four main food

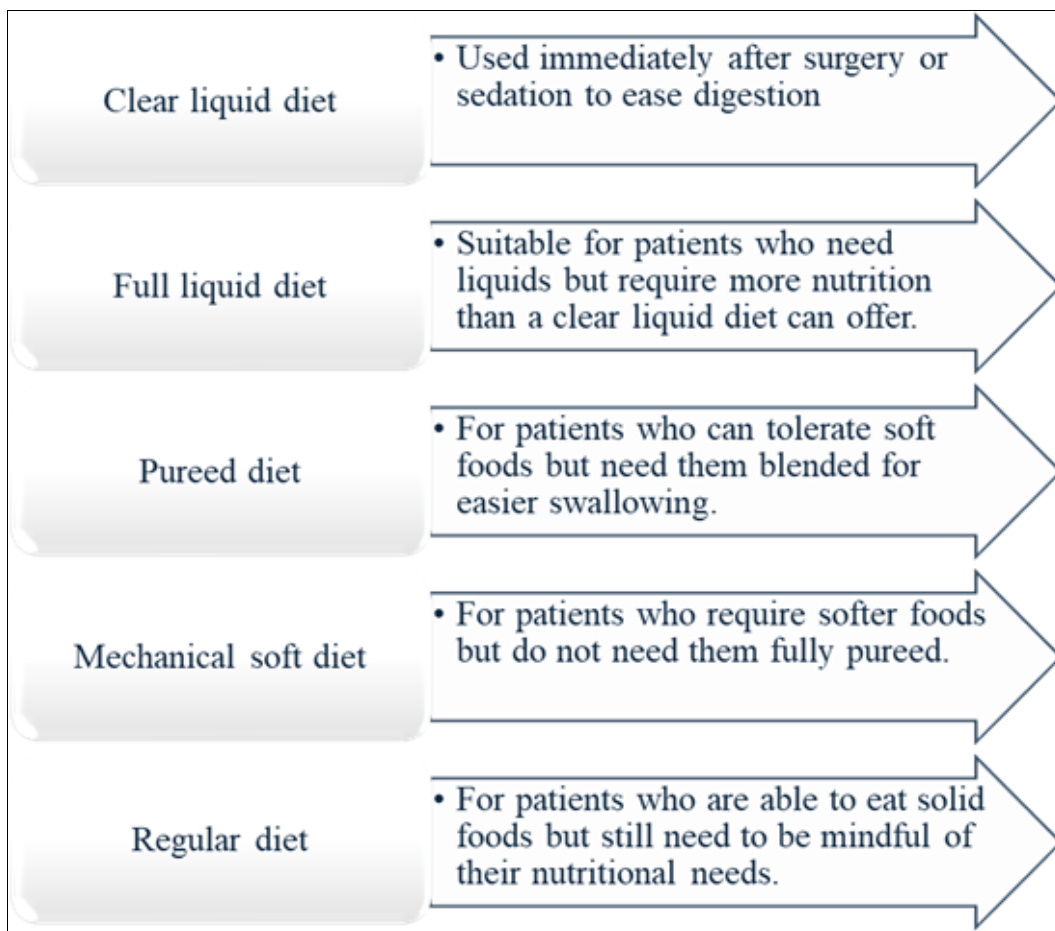
groups, ensures that patients receive the full spectrum of nutrients necessary for tissue repair and overall healing, promoting the best possible recovery outcomes (Figure 5) [49].



**Fig 5:** Four major food groups

Surgery is a state of stress, and the goals of preoperative and postoperative nutrition are to ensure the availability of appropriate nutrients to facilitate rapid healing and recovery. For patients requiring specialized nutritional support during the perioperative period, different types of diets may be

implemented (Figure 6). Some groups have advocated for the use of nutritional screening and assessment tools to determine nutritional status and implement plans to prevent or treat malnutrition [50].



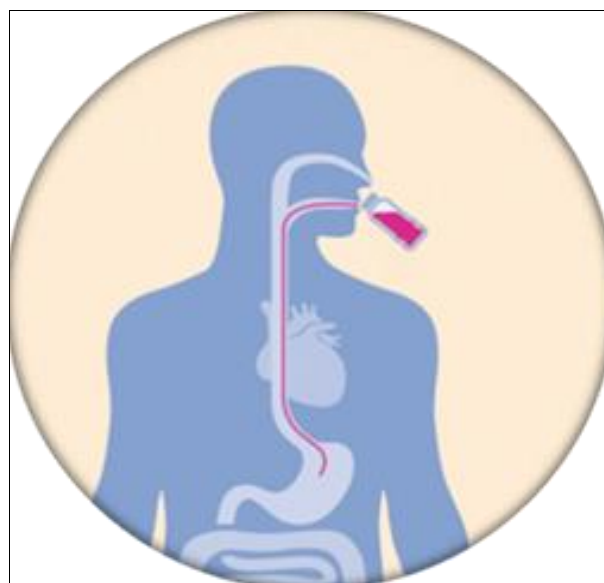
Key Nutritional Considerations in Post-Operative Recovery

**Fig 6:** Types of perioperative nutritional diets

**Nutritional Interventions**

**1. Oral nutritional supplements**

Oral nutritional supplements provide essential macronutrients and micronutrients and are designed to be consumed by mouth (Figure 7), so factors like taste and format are key considerations. These supplements are available as ready-to-drink liquids, powders that can be mixed into drinks, and even in pre-thickened forms. While they can serve as a sole source of nutrition, they are more commonly used to supplement regular meals. Oral nutritional supplements (Figure 8) offer an effective and non-invasive solution for managing disease-related malnutrition in patients who can eat some regular food but not enough to meet all their nutritional needs. They are beneficial for a wide range of conditions, including cancer, stroke, neurological and gastrointestinal disorders, and recovery from surgery. In situations where patients struggle to maintain adequate oral intake due to pain or swelling, oral nutritional supplements may become essential. High-protein, high-calorie supplements can help fill the gap between the body’s nutritional requirements and what is consumed.



**Courtesy:** <https://www.medicalnutritionindustry.org/about-mni/about-medical-nutrition/oral-nutritional-supplements/>

**Fig 7:** Oral route

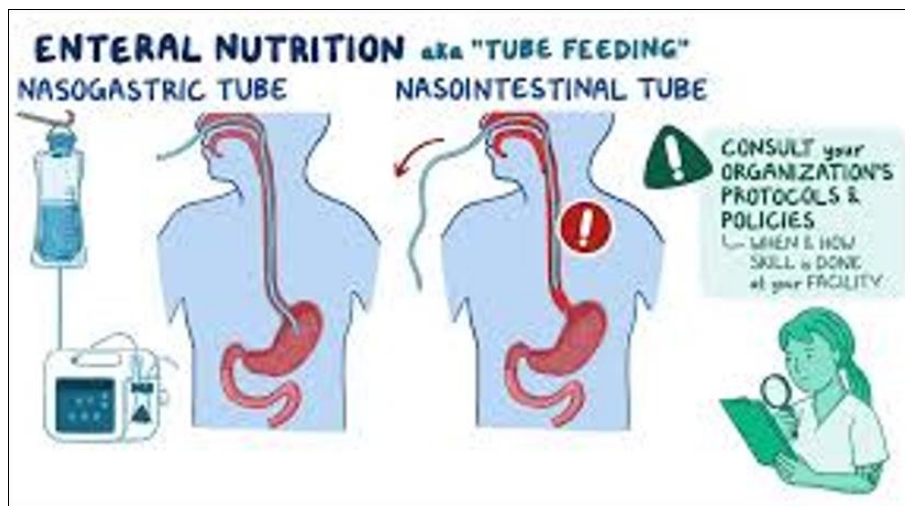


Courtesy: <https://arvadapharmacy.com/medical-supply/oral-nutrition-and-supplements/>

**Fig 8:** Oral nutrition supplements

**2. Enteral Nutrition:** For patients unable to consume sufficient calories or nutrients orally for an extended period, enteral feeding via a nasogastric tube or gastrostomy tube

may be considered (Figure 9). Enteral feeding ensures the patient receives essential nutrients while minimizing the risk of aspiration [52].



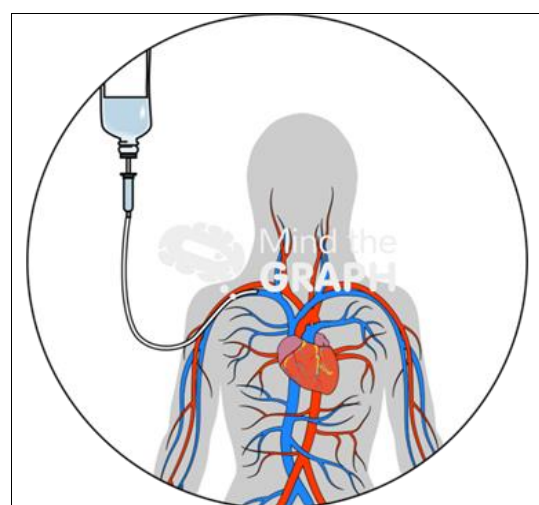
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**Fig 9:** Enteral nutrition

**3. Parenteral Nutrition**

Parenteral nutrition is a method of delivering nutrients directly into the bloodstream, bypassing the digestive system. This approach is used for individuals who are unable to absorb nutrients through their digestive tract due to various medical conditions. It can be administered either as supplementary nutrition, providing additional support alongside regular feeding, or as complete total parenteral nutrition, supplying all necessary nutrients when enteral feeding isn't feasible. In cases where oral or tube feeding is not possible, parenteral nutrition may be used temporarily or on a long-term basis to meet the patient's nutritional needs. (Figure 10) [53].

In some cases, patients may require artificial nutritional support, such as enteral feeding or parenteral nutrition, depending on the severity of their condition and their ability to eat. Once gastrointestinal tolerance improves, patients can be gradually transitioned back to a regular diet [54].



Courtesy: <https://mindthegraph.com/illustrations/parenteral-nutrition-subclavian-vein-body/?breadcrumbs=cardiology&from=subcategory>

**Fig 10:** Total parenteral nutrition



A full liquid diet, which is nutritionally balanced, is particularly beneficial for those unable to chew or swallow solid foods, although caution is needed for patients with

lactose intolerance, as these diets often include milk-based products (Figure 11) [55].

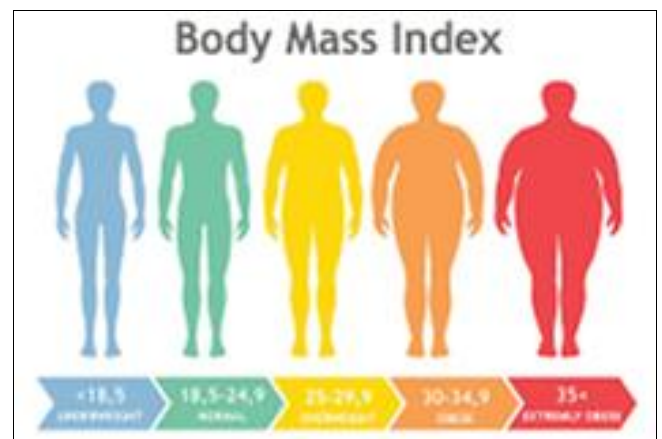


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Fig 11: Full liquid diet

A pureed or mechanically soft diet can act as a transitional phase, providing food with more texture while still being easy to swallow, offering variety and flexibility to prevent dietary monotony. For example, meats can be thinned with liquids like milk to create broths, and fruits can be incorporated into dishes to enhance flavor [56]. Nutritional support is essential for patients who cannot meet their nutritional needs through diet alone. However, providing artificial nutritional support to well-nourished or mildly malnourished patients may offer limited benefit and could even increase morbidity. In contrast, for malnourished patients, appropriate nutritional support can enhance tissue repair, promote collagen maturation, bolster the immune system, prevent muscle loss, improve muscle function, and lower the risk of sepsis [57]. All patients should undergo a perioperative nutritional assessment by a dietitian as part of a collaborative, multidisciplinary approach to addressing nutritional deficiencies. When assessing a patient's nutritional status, it is important to consider factors such as preoperative weight, any recent weight loss, loss of appetite, and difficulty swallowing. This thorough evaluation ensures that any nutritional concerns are identified and managed early, supporting optimal recovery and surgical outcomes [58]. Additionally, unintentional weight loss exceeding 10% of body weight over a 6-month period is considered significant and should prompt nutritional intervention. Nutritional assessment should include a calorie-to-nitrogen ratio based on daily dietary intake [59]. The evaluation of nutritional status should also encompass the height-to-weight ratio, muscle wasting, triceps skin fold thickness, arm circumference, and creatinine height index. Body mass index (BMI) should be calculated by dividing body weight in kilograms by the square of height in meters (Figure 12) [60]. Laboratory tests, including hematological evaluations, help uncover potential causes of oral or systemic diseases. A complete blood count should be conducted to assess immune

function, while other laboratory data provides valuable information on electrolytes, serum proteins, trace elements, glucose, lipids, and organ function [61].



Courtesy: <https://www.linkedin.com/pulse/importance-bmi-health-nutrition-weight-maintenance-healthier-khan-hi8yf>

Fig 12: Body Mass index

The gastrointestinal tract plays a crucial role as an immune organ. Patients with upper gastrointestinal tract cancers often suffer from severe protein-energy malnutrition, and in these cases, enteral nutrition is preferred over parenteral nutrition [62].

Immuno nutrition should be considered for both critically ill patients and those undergoing elective surgeries.

Recommendations:

**Level 1:** Patients with chronic malnutrition benefit from nutritional support.

**Enteral nutrition**

- Preferred over parenteral nutrition in patients with a functional gastrointestinal tract.
- Should be initiated within 18 hours of injury in burn patients.
- Should be started within 24 hours of admission in critically ill patients.

**Immunonutrition:** This should be used for malnourished patients undergoing elective gastrointestinal surgery. Immuno nutrition should be administered for an initial period of 5 to 7 days, after which the patient's condition should be re-evaluated [63].

**Level 2:** Patients with severe head injuries who do not tolerate gastric feeding within 48 hours of injury should receive post-pyloric feeding. Nutritional assessments should be performed weekly, and adequate nutritional support should be provided to meet each patient's individual needs.

**Level 3:** Patients who have not been fully resuscitated should not receive direct small bowel feedings due to gastric intolerance. Intra-gastric feeding for patients with severe closed head injuries should be initiated within 12 hours of admission. In severely injured patients, parenteral nutrition should be started within 7 days if the patient is unable to tolerate at least 50% of their caloric requirements [64].

**Future Prospects:** Nutritional awareness is essential for improving outcomes in oral and maxillofacial surgery. Integrating nutrition into surgical training is critical, as evidence strongly supports its role in optimizing patients for surgery and enhancing recovery. To stay current with evolving nutritional research, oral and maxillofacial surgeons should engage in ongoing education, such as webinars or continuing education courses [65]. This ensures that patients receive a "nutritional tune-up" preoperatively, which can significantly reduce complications and improve healing. The future of nutrition in oral and maxillofacial surgery lies in personalized, targeted interventions [66]. Routine preoperative nutritional screening will help identify patients at risk, enabling tailored interventions such as oral supplements, enteral feeding, and counseling, particularly for those with chronic conditions like diabetes or cancer [67]. Advancements in supplementation, such as novel amino acids, collagen peptides, and immune-supportive micronutrients, could further enhance recovery and reduce complications. Bioavailable, easily absorbed supplements will increase the effectiveness of nutritional support. The growing concept of "immunonutrition" is also promising, using specific nutrients to boost immune function, reduce inflammation, and improve surgical outcomes [68]. Additionally, wearable technology and digital tools for remote nutritional monitoring will enable continuous assessment of a patient's nutritional status, offering a dynamic, patient-centered approach to care. Future success will also depend on multidisciplinary collaboration, where oral surgeons, dietitians, and healthcare providers work together to optimize patient care from preoperative assessments to postoperative rehabilitation. As research advances, these personalized, integrated nutritional strategies will play a crucial role in improving surgical outcomes, shortening recovery times, and minimizing complications [69].

**Conclusion**

Nutrition is critical for recovery after oral and maxillofacial

surgery, supporting tissue repair, immune function, and muscle preservation. Adequate intake of protein, vitamins, and minerals is essential to optimize surgical outcomes during the perioperative period. A personalized nutritional approach—via preoperative screening, tailored diets, and supplementation—can reduce complications like infection, wound dehiscence, and delayed healing. This is particularly important for patients at risk of malnutrition due to chronic conditions or surgery type. Advances in immunonutrition and technology-based monitoring highlight the need for individualized care. Collaboration between surgeons, dietitians, and healthcare teams is key to improving outcomes. Incorporating nutrition into all stages of care is essential to enhance healing, reduce complications, and improve surgical success.

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