

# Perioperative Nutritional Support in Orthopaedic Surgery: A Narrative Review

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## ABSTRACT

Musculoskeletal problems occurs with severe fractures, congenital or inherited diseases, persistent arthritic or overuse conditions of the limbs, joints or other soft tissues like nerves, muscles and ligaments. These disorders may impact people of any age group at any time, who are handled using either surgical or non-operative methods. The outcome and effects of orthopaedic surgery rely on several aspects such as the type of operation done, hospital services, physical treatment, post-operative conditions and the individual's medical status and general health. Nutritional requirements are raised during the perioperative phase, play a significant role in increasing wound healing time, minimizing postoperative complications, early recovery, reducing the chance of surgical site infection, encouraging early regeneration and decreasing hospital stay. Nutrition is the association of nutrients and other substances in food with respect to individual's development, preservation, disease progress, and fitness. It encompasses intake of food, ingestion, biosynthesis, assimilation, catabolism and excretion. There are macronutrients which are needed in relatively large amount including carbohydrate, protein, fat whereas micronutrients are the minerals and vitamins which are needed in smaller quantities. While there are various nutritional screening methods, there is no uniform norm for orthopaedic patients to test or determine nutritional requirements.

**Keywords:** ERAS, Metabolic response, Nutrition, Nutritional assessment, Nutritional supplements.

## INTRODUCTION

Orthopedic disorders are surgical cases that involve hundreds of millions of people globally that are often related to dislocations, fractures.<sup>[1]</sup> In orthopedic patients, prevention and correction of malnutrition has major impact in preventing operative and post-op complications, particularly in the geriatric age group. A dietary state of pre-operative patients indicates the safety status and immune system that also impacts patients' resistance to surgical pain, post-operative physical rehabilitation, local wound healing and surgical site infection.<sup>[2]</sup> Immunological shifts arise quickly with malnutrition of protein calories combined with extended convalescence, decreased susceptibility to illness, anaemia, edema, skeletal muscle fatigue, both attributable to body protein deficiency. Often impacting immunity is undernourishment of trace substances such as magnesium, zinc, vitamins. Post-operational adverse effects may arise due to age factor, the patient's nutritional condition as well as related co-morbidities. Elderly people are considered to have low immune reserves and are unable to adapt well to surgical injuries. Because of these reasons, immunity is reported to be compromised in elderly people and

higher levels of post-operative infection.<sup>[3]</sup> Thus, it is important to research and evaluate the nutritional pre-operative state of all surgical patients, particularly the elderly. Nutrition in orthopedic patients is critical as it facilitates wound healing, maintains lean body mass, avoids postoperative complications and helps in early recovery, on the contrary, malnutrition may contribute to delayed wound healing, increased risk of infection, pressure ulcer, increased morbidity and mortality, above all, extended hospital stay and related complications. Sick people fail to fulfill their nutritional and hydration requirements and as a result 20-50 per cent of patients are undernourished or at a greater risk of deficiency during hospital admission 1 in 5 patients do not eat enough food to satisfy their energy or protein requirements. Malnutrition also has a detrimental effect on the effectiveness of a number of treatments including antibiotics. Malnutrition is preventable and often reversible with nutritional rehabilitation sufficient early on. Malnutrition identification is focused on anthropometric, biochemical and physical parameters.

### Mechanism and Metabolic Response to Injury

Nutritional deficiency results from the hypermetabolic catabolic status related to the inflammatory reaction to the injury. Trauma and hyperactivity cause a state of deprivation and immunocompetence failure. An orthopedic surgery may bring tremendous stress to the body because its metabolism is increased when it is under recoupment. Injury will exacerbate the nutritional

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condition by inducing an inflammatory reaction that raises the basal metabolic rate and the usage of energy while impairing organ function and immune response. The systemic response to injury and surgical response is characterized by activation of sympathetic nervous system, endocrine reaction with pituitary hormone secretion and insulin tolerance while under repair mode.<sup>[4]</sup> Immunological and haematological modifications include cytokine release, acute phase reaction, leucocytosis of neutrophils and migration lymphocytes into inflamed tissues. The ultimate metabolic result of the hormonal transition is enhanced catabolism that mobilizes glycogen, carbohydrate, protein and releases glucose, fatty acids and amino acids into the bloodstream. Catabolism induces muscle tissue damage and is important for functional recovery. Cortisol stimulates the development of glucose attributable to decreased hepatic glycogenolysis and therefore raises the blood glucose content due to surgical or trauma-related stress.<sup>[5]</sup> Poor glycaemic regulation in patients with diabetes is associated with an increase in diabetic complications, the possibility of prolonged perioperative hyperglycaemia involves wound infection and reduced wound healing. The skeletal muscle is decomposed and catabolized for energy or used to shape new proteins. The liver transforms amino acid into ketone bodies, the protein catabolism of patients with post-surgical and severe injury results of pronounced weight loss and muscle wastage. The dietary perioperative state influences the physiological reaction to the procedure. Preoperative dietary replenishment improves the metabolism reaction postoperatively. Treatment success and healing from surgery are impaired because there is inadequate caloric consumption. Elderly and comorbid patients who undertake complicated procedures face nutritional problems and should be marked with a satisfactory diet treatment program.

**Key aspects of Peri operative care include:**

1. Nutrition incorporation into optimal health care
2. Optimizing lengthy pre-op fasting times
3. Restore feed as early as possible.
4. Early nutritional Therapy
5. Reduction of the catabolism factor related to stress
6. Fast mobilization to enhance protein synthesis activity in the muscles

**Nutritional Support**

According to the European Society for Clinical Nutrition and Metabolism (6), nutritional support is either orally supplied by regular diets, therapeutic diets or fortified foods or nutritional supplements, or through enteral nutrition to prevent or treat malnutrition.

**The Guidelines on Nutritional Care includes:**

- a) **Detailed nutritional and medical history**

The relationship of diet and wellbeing is an essential factor for assessing the result of any health condition; quality of life and the surgery. Assessing nutritional status involves testing for symptoms of disease, recognizing clinically related deprivation and tracking any improvements in nutritional status.

- b) **Physical / Geriatric assessment**

The evaluation covers diet, vision, speech, bowel and urinary incontinence, and balance of geriatric community. Knowledge is obtained on improvements in weight, body mass index or weight history of patients. It assists in the evaluation of medical disorder, recovery and follow-up care. Patients with comorbidities should be evaluated about the present status of the coexisting disease.

- c) **Assessment of nutritional and clinical outcome**

Clinical effects in patients who undergo surgical procedures, primarily rely on their nutritional status. It records a clinical history of anthropometric, dietary, and biochemical measurements. Nutritional appraisal seeks to identify the nutritional status of individual, to classify clinically related deficiency and to track improvements in nutritional status. For both cases nutritional counseling is recommended even without any apparent illness, comorbidity or malnutrition. If the patient cannot feed or maintain adequate oral intake during the peri-operative period, dietary therapy should be initiated. The reason for dietary therapy in ortho-surgical patients is preventive, catabolism care and prevent starvation to avoid post-op complications.

**Nutritional Assessment**

It is an in-depth review of the diet, nutrient intake, environment, and medical history of an individual, resulting in a care plan, action, helping to maintain a healthy and secure nutritional status. There are a number of diagnostic methods and strategies used to determine the nutritional condition of surgical patients such as Nutritional Risk Screening 2002,<sup>[7]</sup> Selective Regional Evaluation and Standardized Screening Test for Malnutrition.<sup>[8,9]</sup> Defines the nutritional condition as determined by food consumption and usage. This can be analyzed on the basis of anthropometric, biological, clinical and dietary evidence to assess if an adult is well fed or malnourished.

**Anthropometric markers:**

This covers the history of weight, nutrition, comorbid illness, stress level, physical symptoms (fat, muscle wasting, edema, etc.).

**Biochemical markers:**

This requires hemogram, count of lymphocytes, albumin, CRP, glycoprotein, transferrin, tests of iron and also urinary creatinine. Albumin is the most plentiful protein in human serum while the

abundance of albumin reduces with age. Higher rates of post-operative complications have been reported with patients with hip fracture in cases where albumin amounts below 35 gm/L, and may also induce sepsis. It is often stated that if serum albumin amount is below 35gm/L, or TLC is below 1500c / cm, recovery may be sluggish or challenging. Therefore, albumin is essential for retaining colloid osmotic pressure at the wound healing site and for transporting amino acids to promote wound healing. (10)

### **Clinical Markers**

The condition of a person's disease may increase the likelihood of malnutrition due to increased demand for energy, decreased energy intake or increased nutritional loss. It provides medical history information which may increase nutrient requirements or lead to malabsorption.

### **Dietary Data**

It requires the dietary consumption for micronutrients as well as the composition of macronutrients, describes conditions that impair sufficient consumption and food intolerance. Dietary assessment helps to improve a patient's overall health.

A comprehensive Nutritional Risk Screening (NRS) will be conducted as a standard prerequisite for all medical patients after induction itself. NRS (2002) provides easy and fast first-line technique for identifying patients at risk of malnutrition and is a common test that aims to identify certain nutritional shortages. It comes with four components.

- BMI
- Weight loss in 3-6 months
- Reduced dietary intake
- Acute disease effect

With risks of malnutrition the patient will undertake more comprehensive nutritional evaluation to determine different nutritional problems. Adequate and effective delivery of dietary care is associated with positive effects such as decreased hospital stay, lowered mortality and less surgery-related infections and wound healing.

The presence of frailty is significantly associated with mortality, adverse outcomes, prolonged hospital stay and delayed discharge from the hospital after polytrauma. In older geriatric patients, extensive evaluation should be carried out including

- Documentation of food intake
- Any oral nutritional supplement intake
- Enteral and parenteral intake (in case of insufficient oral intake)
- Nutritional counseling.

### **Pre op Nutrition Supplements**

The pre-op dietary review aims at recognizing and improving patients nutritional status due to accident

and surgery. The effect of pre-op nutritional supplements of either enteral or parenteral appropriate nutrients can substantially shorten hospital stay and mitigate post-operational risks in patients at high risk. Malnutrition is very common among orthopedic patients, but is undiagnosed and unidentified as patients do not receive adequate nutritional treatment. Nutritional assistance for people with malnutrition needing surgical intervention can be suggested. Reduced calorie consumption results in fat reduction, muscle loss and associated weight loss. The stress of trauma and surgery produces a catabolic condition which increases the requirement of protein and energy.<sup>[11]</sup> Malnutrition is very common in elderly people and is associated with reduced muscle mass and increased risk of chronic disease. Suitably nourished elderly people heal more easily from injuries and surgery than adults. The catabolic state and the inflammatory reaction which occur in response to trauma of both fracture and surgery is severe in hip fracture patients. The prolonged inflammatory response may be related to the state of malnutrition which results in loss of skeletal muscle mass, impairment of cellular immune and muscle function.

### **Intraoperative Nutrition**

The introduction of Enhanced Recovery After Surgery (ERAS) was a revolutionary change and it includes a metabolic strategy to reduce stress and improve nutrition by.<sup>[12]</sup>

- Food incorporation into overall health care.
- Reduction of NPO time and reintroduction of oral feeding as soon as possible after surgery.
- The nutritional therapy begins early as soon as nutritional danger is evident.
- Glycaemic regulation and elimination of stress-related catabolism factors;
- Early mobilization to make protein synthesis and muscle function easier.

### **Post op Nutrition Supplements**

Early enteral nutrition is associated with significant reduction in morbidity and mortality provided adequate nutrition improves post-op outcomes. Patients consuming pre-operative parenteral feeding would have restarted themselves on the first post-operative day.<sup>[13]</sup> The consumption of magnesium, calcium, zinc and Vit D by orthopaedic surgical patients was all less than prescribed (Hantivell 2004).<sup>[14]</sup> Ageing is correlated with a reduction in muscle mass and an rise in chronic diseases, while obesity can be found in any age demographic, the risk is highest in the population over the age of 65, hip fractures and is more vulnerable to adverse results.<sup>[15]</sup>

An orthopedic surgery will place tremendous stress on the body when it elevates the metabolism of the body as it is in the phase of repair. A well-balanced and nutritious diet is essential for proper growth,

repair and rapid recovery of tissues. Food demands vary from 25 to 35 kcal / kg / day for orthopedic patients and protein needs from 1.2 to 2.0 gm / kg / day.<sup>[16]</sup> Protein makes up 55% of the bone volume and is a main component in bone healing. Protein can prevent bone degradation, reduced post-surgical infections, and improved bone density. Protein deficiency can contribute to decreased bone building factors that limit healing, Calcium and Vit D influence bone health and inadequate ingestion of these micronutrients are correlated with osteoporosis, bone fracturing, impaired healing, and non-union. For elderly patients with hip fracture for particular, calcium and Vit D treatment has been prescribed to reduce post op complications. It should be supplemented and corrected in patients with Vit D and calcium deficiency before surgery itself. Research shows that calcium absorbed in nutritional type coupled with CHO, lipids, and other nutrients in food increases the synthesis of calcium. Even inadequate consumption of calcium is correlated with osteoporosis, and danger of fracture. If sufficient dietary consumption of calcium cannot be prescribed is supplemental calcium, but calcium citrate is the main form of calcium supplementation. Vit D acts with calcium to improve bone strength, as it can digest and use calcium. The deficiency raises the likelihood of non-union muscle fatigue and osteoarthritis development. Vit D deficiency has been identified in patients with hip fracture, low Vit D status has been linked with cases of non-union and stress fracture.

Several studies have concluded that Vit D rates > 35ng / mL are necessary for optimal bone health.<sup>[17]</sup> Vit D3 is supplemented with calcium which is more effective. Nonetheless, lately calcium supplements have been related to elevated chances of MI; dietary calcium is not correlated with any heart attacks. Vit K is fat soluble vitamin which acts as a coagulation factor and acts as a co-factor in osteocalcin carboxylation for the skeleton. High Vit K results in higher carboxylated osteocalcin contributing to poor density of the bone mass. Clinical trials also note that Vit K improves bone mineral density in osteoporosis but also decreases fracture levels to enhance bony health. The American Medical Association raised the daily reference doses of Vit K for females to 90 mg / dl and males to 120 mg / dl. Several studies have shown that low dietary Vit K has poor bone mineral density and increased hip fracture. Vit C is also an effective micronutrient with a suggested daily dose of 75 mg for women and 90 mg for men for adults. Observational evidence suggest that high dietary intake and Vit C supplementation in post-menopause women can reduce the risk of hip fracture. This is an important micronutrient with research that confirms its function in bone growth, tissue regeneration and the development of collagen. It also helps in reducing oxidative stress following surgery. It

contributes to musculoskeletal health through carnitine and collagen biosynthesis and thus improves the absorption of dietary iron by the intestines. Work in orthopedic surgery focused on the effects of Vit C on fracture repair, avoiding complicated regional pain syndrome and osteoarthritis pathophysiology.

#### **Perioperative nutritional support in:**

##### **a) Diabetes Mellitus**

Over eating is often a type of malnutrition, i.e. an unbalanced diet resulting from inadequate food consumption contributing to accumulation of health-impairing body fats. The nutrient intake exceeds the amount required for normal growth, production, and metabolism. This not only contributes to the progression of diabetes but also associated complications. The goals of medical treatment and diet to improve long-term safety would be to maintain average blood glucose levels without excessive chance of regular hypoglycaemia.<sup>[18]</sup> Appropriate calorie intake should be kept in mind and prevention of acute and chronic DM complications. The primary goal is to enhance the standard of living and, thus, live a healthy life. Oral and enteral feeding can be provided, but should be followed by OHA's if clinically suggested. Diabetic patient may need a higher dose of subcutaneous insulin during the post-operative time due to surgical stress. Closer control and optimization of the blood sugar levels is also relevant.

##### **b) Hypertension**

Perioperative hypertension is a widely found issue in patients; it is one of the most prevalent chronic medical problems which raises the occurrence with age.<sup>[19]</sup> BP is often shown to be elevated during anaesthesia induction, intraoperative due to fluid pressure, vasoconstriction due to sympathetic stimulus caused by pain. Degrading or restricting the aggravation of bleeding and harm to vital organ is necessary.<sup>[20]</sup> Nutritional changes such as DASH Protein diet, low-fat dairy products, high-fibre-diet. Sodium, potassium, calcium, and magnesium influence blood pressure and it is essential to minimize BP.

##### **c) Chronic Kidney Disease**

Perioperative medical treatment for CKD patients includes evaluation of nutritional status and modification to diet. Dose of medications to manage malnutrition and daily intake of nutrients is dependent on dietary restrictions involving absorption of water, sugar, phosphorus, potassium and vitamins. Due to fluid restriction and diuretics, these patients are at risk of lean body mass loss, starvation, dehydration. Correction of anemia is important factor in the perioperative period.

**d) End Stage Liver Disease**

Malnutrition in patients with liver disease is caused by various factors such as reduced intakes of nutrients and calories, intestinal absorption and overloaded catabolism. The liver plays critical role in controlling the absorption of carbohydrate, protein, and lipids. Perioperative care of patients with liver disease is emphasized for improving surgical outcomes and thus preventing surgical site infection. Impaired absorption of fat and fat-soluble vitamins may outcomes in vitamin deficiency causing complications after surgery. Early intervention replenishes the deficit of nutrients that can reduce risks and improve the quality of life. Usually correction of proteins like albumin and globulin is important in the perioperative period with respect to coagulation factors and drug metabolism.

**CONCLUSION**

Although malnourished patients make poor surgical candidates and are associated with increased risk of SSI and cardiac, renal and respiratory insufficiency, post-op delirium, venous thromboembolism, wound dehiscence and other complications. Adequate evaluation and optimization of pre-op nutrition by consuming high protein diets and oral nutrition supplements that boost post-operative outcomes. A dietician must be engaged in the dietary needs of pre-op cases, particularly for patients with comorbidity. Because perioperative nutritional assistance contributes to a decrease in significant postoperative problems, it is important that a thorough nutritional evaluation of all patients undertaking orthopedic surgery be performed at baseline to classify individuals at risk or undernourished in order to ensure positive surgical results and thereby optimize postoperative patient care. Perioperative nurses may serve as nurse navigator to facilitate perioperative interaction for patients across a variety of instructional and clinical interventions.

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