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# 'CALCIUM METABOLISM'- Pertinence to Prosthodontics- A Narrative Review

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**ABSTRACT:**

For prosthodontic operations to be successful, particularly those involving dental implants and the preservation of alveolar bone, adequate calcium levels are necessary. In order to prevent excessive ridge resorption and maintain the stability and effectiveness of dental prostheses, it is imperative to maintain adequate quantities of calcium through diet or supplementation. It is essential for healthy blood clotting, maintaining strong bones, facilitating normal muscle and nerve function, and supporting the strength and shape of teeth.

Key Words: Calcium Metabolism; Calcium Absorption; Calcium Deficiency and Dental Health; HyperCalcemia.

**INTRODUCTION**:

The processes that control the body's calcium levels and guarantee sufficient calcium availability for different physiological processes while preserving equilibrium are referred to as calcium metabolism. Calcium is necessary for a number of vital processes, such as blood clotting, muscular contraction, nerve transmission, and bone health[1].

The endocrine system of parathyroid hormone (PTH) and vitamin D, which is comprised of multiple homeostatic feedback loops, plays a major role in controlling the metabolism of calcium. To keep serum ionised calcium levels appropriate, bone mineral must be released from the body quickly.[2]

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**I. Step by step procedure of calcium metabolism** :

The processes that make up calcium metabolism guarantee that the body's calcium levels are properly regulated. The methodical procedure guarantees that the body keeps the right amounts of calcium, which is essential for many physiological processes. A detailed flowchart of the procedure is provided below:[3]

1**. Consumption of Calcium in Food**

Source: Food is the main way that the body absorbs calcium. Dairy products, leafy greens, almonds, and fortified meals are common sources.[4]

2. **The Small Intestine's Absorption of Calcium**

In the small intestine, there are two main ways that calcium is absorbed:

a). The mechanism that depends on vitamin D is responsible for the active transportation of calcium in the duodenum and jejunum. Calcium-binding proteins are made when vitamin D is stimulated, and this helps the body absorb calcium.

b). Passive Diffusion: Depending on the gradient in concentration between the blood and the intestinal lumen, calcium is absorbed passively in the ileum.[5]

3. **Transport in Blood**

Calcium is absorbed and then goes into the bloodstream, where it is either carried free and ionised or attached to proteins, primarily albumin.

4. **Bone Formation and Resorption**

Bone Storage: The bones and teeth contain 99 percent of the calcium in the body. To keep calcium homeostasis intact, there must be a balance between bone growth and resorption.

Bone Resorption: When osteoclasts break down bone, calcium is released into the blood.

Osteoblasts contribute to the strength and structure of bones by laying down calcium in the bone matrix during the formation of new bone.

5. **Hormonal Regulation**

Hormone Parathyroid (PTH):

released when blood calcium levels are low by the parathyroid glands. raises blood calcium levels by vitamin D activation, increased kidney calcium reabsorption, and bone resorption stimulation.

Vitamin D:

Calcium absorption in the intestines, reabsorption in the kidneys, and promotion of bone mineralisation are all improved by vitamin D, and more especially by its active form, calcitriol.

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Calcitonin

By reducing osteoclast activity and raising calcium excretion in the kidneys, the thyroid gland's secreted chemical calcitonin decreases blood calcium levels.

6. **Renal Calcium Reabsorption and Excretion**

Function of the Kidneys: The kidneys filter calcium, most of which is then reabsorbed into the blood. The remaining calcium is eliminated in the urine, and the kidneys control this process according to the body's needs.

7. **Feedback Mechanisms**

Negative Feedback Loop: To maintain equilibrium, the release of PTH, calcitonin, or vitamin D is triggered by changes in blood calcium levels. This negative feedback loop is responsible for controlling calcium levels. Reference 10

8. **Calcium Utilization in the Body**

Muscle Contraction: Calcium is essential for muscle contraction because it binds to troponin, which makes actin and myosin connect easier.

Neurotransmitter release at synapses is dependent on calcium for nerve function.

Calcium plays a crucial role in the cascade of blood coagulation. [11]

9. **Calcium Depletion**

Excretion Pathways: Urine is used to eliminate calcium that is not reabsorbed in the kidneys. Excreta and perspiration also lose trace amounts of salt. [12]

## II. Daily calcium requirement of adults and geriatric patients:

Age, gender, and life stage all affect how much calcium is needed each day. The recommended daily intake of calcium for adults and elderly patients is summarised here:

1. Individuals between the ages of 19 and 50

Calcium: 1,000 mg per day is the recommended daily amount (RDA) for both men and women.

women who are nursing or pregnant: 1,000 mg per day is also the RDA.

2. Adults Over 51 (51-70 Years)

Men: 1,000 mg per day is the recommended daily allowance for men between the ages of 51 and 70.

Women: The daily recommended dosage for women in this age range is 1,200 mg. The increased risk of osteoporosis resulting from postmenopausal bone loss is the cause of this higher requirement.[13]

 

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3. Senior Individuals (71 Years and Above)

For both genders, the recommended daily allowance (RDA) is 1,200 mg for those 71 years of age and above. Older persons have a greater demand because of things like decreased calcium absorption and an increased risk of bone-related diseases like osteoporosis. In [14]

**Dietary Sources**: Dairy products, leafy greens, and fortified meals are good places to start when looking for calcium in food. For those who cannot achieve their goals through diet alone, supplements could be required.

**Vitamin D**: For the body to absorb calcium, adequate amounts of vitamin D are essential, particularly in older persons. It is frequently advised to take calcium and vitamin D supplements together to avoid osteoporosis. In [15]

## III. Importance of calcium in general health and dental health:

Calcium is an essential mineral that is necessary for sustaining general health in multiple ways.

A). **Bone Health**: Calcium serves as structural support for teeth and bones and is the main mineral found in them. The body stores 99% of its calcium in the form of bones and teeth. Strong bones require proper calcium intake for proper development, growth, and maintenance. Osteoporosis and fractures are among the conditions it helps avoid [16].

B). **Muscle Function**: In order for muscles to contract, calcium is necessary. Muscle contraction and relaxation are made possible by its interactions with muscle cell proteins. In order to sustain a healthy heartbeat, adequate calcium levels are necessary for appropriate muscular function, including the heart's muscles. [17]

C) **Nerve Transmission**: The release of neurotransmitters in nerve cells, which enables neurones to communicate with one another, depends on calcium. Sufficient quantities of calcium are essential for nerve function, which affects everything from muscular contraction to sensory awareness. [18]

D). **Blood Clotting:** Calcium participates in the blood clotting cascade, a chain of events that stops excessive bleeding after wounds. Inadequate calcium can hinder the blood coagulation process, which raises the risk of bleeding. [19]

E) **Hormonal Secretion**: Enzymes and hormones that control a number of physiological functions, such as digestion and energy metabolism, are secreted when calcium is present. These regulatory systems operate efficiently when calcium levels are appropriate, which promotes general metabolic health.[20]

### *Calcium's Role in Dental Health*

1.**Tooth Development and Maintenance**: An essential part of hydroxyapatite, the mineral that makes up teeth's strong enamel coating, is calcium. Tooth formation requires a sufficient consumption of calcium during childhood and adolescence. Calcium helps individuals avoid dental problems like cavities and tooth decay by preserving the strength and structure of their teeth. [21]

2. **Dental Caries Prevention**: Calcium aids in the remineralisation of enamel, mending early indications of tooth decay and averting cavities. Stronger enamel and a decreased risk of dental caries (cavities) are benefits of a diet high in calcium. To improve enamel strength, fluoride and calcium act together. 22]

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3. **Gum Health**: Calcium helps maintain the alveolar bone, which is responsible for anchoring teeth in place. It affects the jawbone's overall health as well. Sufficient amounts of calcium aid in the maintenance of robust bone surrounding teeth, lowering the risk of gum disease (periodontitis), which can result in tooth loss. 23]

**IV. Regulation of calcium metabolism** :

The intricate hormonal interactions that keep the body's calcium homeostasis intact closely control calcium metabolism. For many physiological processes, including bone health, muscular contraction, neurone function, and blood clotting, stable blood calcium levels must be maintained. This management is essential for achieving these goals.

1. **Parathyroid Hormone (PTH**): The main hormone responsible for controlling blood calcium levels is parathyroid hormone (PTH). Low blood calcium levels cause it to be secreted.

PTH activates osteoclasts, which are the cells that break down bone tissue and release calcium into the blood.PTH improves the kidneys' reabsorption of calcium, which lowers the amount of calcium lost in urine. Calcium absorption from the intestines is increased by PTH-assisted vitamin D activation, which occurs when vitamin D is converted to its active form (calcitriol) in the kidneys.

2. **Vitamin D (calcitriol)** :is a hormone that is produced in the kidneys and is absorbed through the skin, food, and supplements. In addition to being important for bone health, vitamin D is necessary for the intestines to absorb calcium. Increased Absorption of Calcium and Phosphate from the stomach: Calcitriol promotes the absorption of calcium and phosphate from the stomach, raising blood calcium levels. Bone Formation: It encourages the influx of calcium into the bone structure, fortifying it. Feedback Regulation: Excessive calcium release from bones is prevented by high levels of calcitriol, which block PTH secretion. [25]

3. **Calcitonin:** Parafollicular cells, or C cells, of the thyroid gland. While calcitonin's function in adults is less significant than that of PTH and vitamin D, it is a hormone that aids in lowering blood calcium levels when they become excessive.

Calcium chromatinin prevents osteoclasts from breaking down bone, which in turn lessens the amount of calcium released into the blood. By preventing calcium reabsorption in the kidneys, it improves calcium excretion in the urine [26].

4. **Calcium-Sensing Receptor (CaSR):** Kidneys, parathyroid glands, and other tissues that have calcium-sensing receptors (CaSRs). PTH secretion is regulated by the CaSR receptor, which senses variations in blood calcium levels.

CaSR activation results in a reduction in PTH production when blood calcium levels are elevated. On the other hand, low calcium levels cause a decrease in CaSR activity and an increase in PTH release. Calcium reabsorption is controlled by CaSR in the kidneys, which keeps calcium levels within a specific range.[27]

5**. Phosphate Regulation**: There is a strong correlation between calcium and phosphate levels. Elevated levels of phosphate may result in the production of insoluble calcium phosphate, hence lowering the blood levels of free calcium.

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PTH, promotes the excretion of phosphate by decreasing its reabsorption in the kidneys. Together with calcium, vitamin D improves phosphate absorption in the intestines.

6. **Renal Regulation of Calcium**: PTH and vitamin D cause the kidneys to filter calcium, with a large amount of that calcium being reabsorbed back into the bloodstream. The urine contains unabsorbed calcium. For this reason, the kidneys are essential in preserving the calcium balance.[29]

**V. The role of calcium in Prosthodontic treatments**:

The maintenance of oral structures, osseointegration, and bone health are the main ways that calcium affects prosthodontic treatments. This is a summary of its function in different prosthodontic applications:

A. **Bone Density and Health**

The success of prosthodontic procedures, particularly those involving implants, depends on the maintenance of bone density and health, both of which are facilitated by calcium. Sufficient calcium levels support the integrity of the alveolar bone, which acts as a solid base for prosthetics such as dental implants. The stability and durability of prosthodontic therapies may be jeopardised by bone resorption brought on by poor bone health.

B. **Dental Implant Osseointegration**

A dental implant attaches itself to the jawbone through a process called osseointegration. Because calcium is an essential part of the bone matrix and helps with the mineralisation of the implant, it plays a critical role in this process. By encouraging bone formation and healing around the implant site, adequate calcium levels aid in the effective integration of implants. This guarantees stability and long-term use of the implant.[31]

C. **Alveolar Bone Preservation**

Tooth and dental prosthesis are supported by the alveolar bone, which is maintained in part by calcium. Failure of dentures and other prosthodontic appliances may result from alveolar bone loss. The alveolar bone beneath prosthodontic procedures, including as dentures, provides support. Insufficient calcium can hasten bone resorption, which can cause discomfort, ill fit, and the need for regular denture repairs or modifications.

D. **Dental Cement and Calcium Phosphate**

A vital component of many dental cements, especially those based on calcium phosphate and utilised in prosthodontics, is calcium. These cements are used to anchor crowns, bridges, and other prosthetic devices. They extend the life of prosthodontic restorations by fostering biocompatibility and aiding in dentin remineralisation.

E. **Avoidance of Complications with Prosthetics**

Sufficient levels of calcium aid in the avoidance of issues such implant failure, prosthesis instability, and bone resorption. Patients receiving prosthodontic procedures can see better results and greater patient satisfaction if they make sure they are getting enough calcium in their diet. 34]

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G. **Calcium-Related Medications and Prosthodontics**

Bisphosphonates are examples of medications that have an impact on calcium metabolism and how they relate to prosthodontic therapies. The remodelling and mending of bone, which is important in prosthodontics and particularly in treatments involving dental implants, might be impacted by bisphosphonates, which are used to treat osteoporosis. To prevent side effects like osteonecrosis of the jaw (BRONJ), which is caused by bisphosphonates, careful management of these drugs is required. (35)

## VI. Prosthodontic complications in calcium deficiency patients

Lack of calcium can cause a number of issues during prosthodontic procedures, mainly because it is essential for preserving bone density and sustaining the oral cavity's structural integrity. Below is a comprehensive summary of the prosthodontic issues that patients with low calcium levels may experience:

***1. Impaired or Delayed Osseointegration of Dental Implants***: Calcium is essential for bone mineralisation and the healing process that enables dental implants to successfully integrate with the jawbone. When a patient is deficient in calcium, the bone's capacity to heal and integrate with the implant is impaired, which can result in delayed or unsuccessful osseointegration. This may lead to unstable or failing implants, requiring more procedures or different approaches to treatment.[31]

***2. Elevated Danger of Alveolar Bone Resorption***: Insufficient calcium causes a faster loss of bone, especially in the alveolar bone, which serves as support for teeth and dentures. Alveolar bone resorption, which can cause dentures to become loose or ill-fitting prostheses that require regular adjustments or replacements, is more common in patients with calcium shortage. The reduction of bone mass can also make subsequent prosthodontic operations more difficult, including implant insertion.[36]

3. ***. Increased Incidence of Fractures in Prosthetic Structures*** :Results from poor bone quality caused by a calcium deficit, which weakens the bone's structural integrity and increases its susceptibility to fractures. When dental implants or other surgical operations are being performed on prosthodontic patients, this may result in fractures of the mandible. Additionally, either fixed or detachable prostheses may not have enough support from the underlying bone, which could result in mechanical failure of the devices.[37]

4. ***Poor Denture Retention and Stability***: The alveolar ridge, which is crucial for denture retention and stability, shrinks in height and width as a result of bone resorption brought on by a calcium deficit. Due to inadequate bone support, patients may feel pain, an uncomfortable fit, and trouble keeping their dentures in place, especially their bottom dentures. Their quality of life may suffer as a result of this major influence on their ability to chew and speak.[38]

5. ***Increased Risk of Peri-implantitis and Implant Failure*** :Deficit in calcium can weaken the immune system and make it harder for the bone to maintain implants, which increases the risk of peri-implantitis and implant failure. The inflammatory disease known as peri-implantitis, which affects the tissues around dental implants, is more common in patients with low calcium levels. Implant failure may eventually arise from this disorder, which can cause bone loss around the implant.[39]

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6. ***Complications in Bone Grafting Procedures***: Bone grafting is frequently necessary for prosthodontic therapies, particularly implant dentistry. The effective integration of the transplant with the native bone requires calcium. Graft rejection or inadequate bone growth may result from improper integration of bone grafts in patients with calcium shortage. This makes it more difficult to acquire satisfactory results in subsequent prosthodontic treatments. [39]

7. ***A higher vulnerability to Prosthetic Stomatitis***: Prosthetic stomatitis is a condition that affects the oral mucosa behind dentures and is frequently linked to microbial infections. The immune system and mucosal integrity are both aided by calcium. Patients lacking in calcium may experience a weakened mucosal barrier, making them more vulnerable to inflammation and infections. This may cause pain, discomfort, and make wearing dentures challenging.[40]

**VII. Prosthodontic complications withe excess levels of calcium** :

Many difficulties in prosthodontic therapies can result from hypercalcemia, or excessive calcium levels. The main cause of these issues is the systemic influence of high calcium levels on bone metabolism, kidney function, and general health. These consequences can also have an indirect effect on prosthodontic results, such as the following:

1. Affected Bone Remodelling and Resorption: Hypercalcemia can cause abnormalities in the formation and remodelling of bone, which can affect bone resorption and remodelling. In prosthodontics, this can lead to erratic bone behaviour, which makes it challenging to achieve and maintain stable osseointegration of dental implants. Implant instability and failure may result from excessive bone resorption.[41]

2. Impaired Bone Formation and Impaired Healing: Hypercalcemia is frequently linked to decreased bone formation and increased bone resorption, which can impede bone healing following surgical treatments. This may cause issues with the bone's ability to recover after implant implantation or bone grafting operations. When osteonecrosis develops in severe cases, especially in the jaw, hypercalcemia may play a role. This can seriously affect the results of prosthodontics.[42]

3. Enhanced Risk of Soft Tissue Calcification: High calcium concentrations can cause ectopic calcification, a condition in which calcium deposits accumulate in soft tissues, including oral tissues. In the field of prosthodontics, deposits within the soft tissues of the mouth might make it more difficult to fit and put prosthetic appliances like implants or dentures. The discomfort and difficulties in getting the best results from a prosthetic could potentially be caused by these calcifications.[43]

4. Xerostomia and Modified Salivary Composition: An imbalance in the levels of calcium and phosphate can result from hypercalcemia-induced changes in salivary composition. The discomfort and retention of detachable prostheses like dentures can be impacted by this imbalance, which can lead to xerostomia (dry mouth). Prosthodontic patient treatment may become more difficult due to xerostomia's potential to raise the risk of dental caries and mucosal irritation.[44]

5. Increased Risk of Renal Complications Impacting Treatment Planning: Hypercalcemia is frequently linked to renal issues, such as kidney stones (nephrolithiasis) and reduced kidney function. Renal problems may affect the choice and administration of anaesthetics, drugs, and postoperative care in orthodontic procedures. Furthermore, reduced

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renal function may require modifications to the treatment plan, particularly in implant-related surgeries or prolonged prosthetic rehabilitation. [45]

6. Muscle Weakness Caused by Hypercalcemia Affecting Prosthesis Stability: Neuromuscular symptoms, such as weariness and muscle weakness, can be brought on by hypercalcemia. Dentures and other dental prostheses may become unstable or less functional due to muscle weakening, especially in the masticatory muscles. Reduced prosthetic success may result from patients' inability to chew and maintain a correct prosthesis fit [46].

7. Cardiovascular Problems Caused by Hypercalcemia: High calcium levels can lead to heart problems such as arrhythmias and hypertension. These heart problems could affect how prosthodontic patients are treated, particularly if they need anaesthesia for surgery. Preoperative problems can be prevented by closely monitoring and managing cardiovascular health.[47]

## VIII. Dietary supplements for calcium deficient prosthodontic patients:

Dietary supplements can play a critical role in preserving bone health, guaranteeing the effectiveness of prosthodontic therapies, and averting difficulties for patients with a lack of calcium. Here is a thorough summary of dietary supplements that prosthodontic patients who are lacking in calcium may benefit from:

### 1. Carbonate of Calcium

A popular and reasonably priced form of calcium supplementation is calcium carbonate. It is better absorbed when taken with food and has a high amount of elemental calcium (about 40%). Patients in need of high calcium dosages for prosthodontia can use it. Sufficient consumption of calcium promotes the healing process following treatments such as dental implant implantation and helps preserve bone density.[48]

### 2. Citrate of calcium

Approximately 21% of elemental calcium can be found in calcium citrate, another popular calcium supplement. It can be taken with or without food and is more readily absorbed than calcium carbonate. For individuals who use drugs that lower stomach acid or have lower stomach acid levels, which is frequent in older adults, calcium citrate is advised. Long-term use is appropriate for this type since it is less likely to induce gastrointestinal distress.[49]

### 3. Calcium Phosphate

The two elements that are crucial for healthy bones—calcium and phosphate—are found in supplements. Although less often utilised, this type of calcium has the potential to help the body's calcium and phosphate levels remain balanced. Patients who suffer from low phosphate levels, or hypophosphatemia, in conjunction to calcium shortage, can benefit most from this supplement. It is a choice for people who might gain from consuming more phosphate and helps with bone mineralization.[50]

### 4. Calcium combined with vitamin D

To improve calcium absorption, vitamin D and calcium supplements are frequently taken together. The body's management of the metabolism of calcium and phosphate depends on vitamin D. A calcium supplement with

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additional vitamin D is advised for individuals with prosthodontia, particularly those who have little sun exposure or are at risk of vitamin D insufficiency. In addition to promoting osseointegration in dental implants and lowering the risk of fractures, this combination enhances bone health. [51]

**5. Calcium Lactate**

With roughly 13% elemental calcium, calcium lactate is another type of calcium supplement. It is less prone to result in gastrointestinal distress and is readily absorbed by the body. Patients who need a gentler supplement or who might have adverse reactions to other types of calcium are advised to use it. For prosthodontic patients who are lacking in calcium, calcium lactate can assist sustain bone strength and tooth health. [52]

**6. Calcium Gluconate**

In clinical contexts, calcium gluconate—which has an elemental calcium content of around 9%—is frequently utilised, especially in intravenous formulations intended to treat severe hypocalcaemia. Although it's not a popular dietary supplement, calcium gluconate may be taken into consideration in scenarios when there's a need for an immediate correction of calcium levels, such acute deficient situations that could affect the course of dental treatment. [53]

**7. Calcium and Magnesium combination**

In the metabolism of calcium, magnesium is essential. For both minerals to work at their best, supplements that include calcium and magnesium can be helpful. Combining supplements for patients deficient in both calcium and magnesium may assist maintain bone health, lower the likelihood of prosthodontic treatment problems, and improve overall metabolic balance [54].

**8. Calcium Ascorbate**

Vitamin C in the form of calcium ascorbate also contains calcium. In addition to promoting bone health, it is easy on the stomach and has antioxidant advantages. For patients who require both calcium and vitamin C, this supplement is especially helpful. Collagen synthesis and wound healing are critical components of prosthodontic patients' post-surgical rehabilitation [55].

## IX. Role of calcium in ridge resorption:

The metabolism of bone depends on calcium, and a lack of it can have a major effect on ridge resorption, a process that is very important when it comes to dental prosthesis. Ridge resorption is the term used to describe the progressive loss of alveolar bone that can affect the fit and stability of dental prostheses such as implants or dentures.

*1. Bone Remodeling and Calcium Balance*

The proper balance between bone growth and resorption requires calcium. The process of remodelling bones involves the constant reabsorption of old bone and the formation of new bone. In order to maintain bone density, this process requires adequate calcium levels. In people with low calcium levels, the balance between bone creation and resorption

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shifts in favour of higher bone loss. The acceleration of alveolar ridge resorption caused by this imbalance results in a decrease in bone volume and density, which are essential for the durability and retention of dental prosthesis [56].

*2. Calcium Deficiency and Osteoclastic Activity*

When there is a calcium shortfall, parathyroid hormone (PTH) is released, which enhances the activity of osteoclastic cells, which release calcium into the bloodstream by breaking down bone tissue. The alveolar ridge's bone resorption is accelerated by increased osteoclastic activity brought on by low calcium levels. Patients who are edentulous or have removable dentures should be especially careful with this process since it might cause poor prosthesis to fit and impaired oral function if resorption persists.[57]

*3. Bone mineral density and calcium (BMD)*

Hydroxyapatite, the mineralized matrix that provides bone its strength and density, primarily consists of calcium. Ingesting enough calcium is required to preserve bone mineral density (BMD), which is essential for thwarting resorption. Ridge resorption is more likely to occur in areas with low BMD. The loss of alveolar bone density in patients suffering from osteoporosis or chronic calcium shortage complicates the preservation and durability of dental prosthesis by increasing the rate of resorption.[58]

*4. Vitamin D and Calcium Metabolism*

When it comes to the intestinal absorption of calcium, vitamin D is essential. Hypocalcaemia (low calcium levels) results from inadequate vitamin D, which impairs calcium absorption. Ridge resorption is made worse by low vitamin D status, which results in insufficient calcium, especially in older persons who are more likely to have low vitamin D levels. The long-term results of prosthodontic procedures may be considerably impacted by this. [59]

*5. Alveolar Ridge Resorption and Systemic Bone Loss*

Low bone mass and microarchitecture degradation are hallmarks of systemic disorders like osteoporosis, which are frequently associated with calcium insufficiency. Because of the general weakening of the bone structure, people with osteoporosis usually experience increased alveolar ridge resorption. Because appropriate alveolar bone is the cornerstone for dental prosthesis, this can complicate their design and success [60].

*6. Supplementing Calcium and Preserving Ridges*

In people with poor dietary calcium consumption, especially postmenopausal women, supplementing with calcium has been demonstrated to slow down the rate of bone loss. Calcium supplementation can lessen the rate of ridge resorption in the context of dental health by lowering alveolar bone loss. Patients without teeth who depend on the alveolar ridge to keep their dentures stable will especially benefit from this.[61]

**X. Effect of Systemic medication on calcium metabolism** :

The metabolism of calcium is influenced by systemic drugs, which can have a major effect on bone health, calcium levels, and other physiological processes. An outline of how different systemic drugs affect the metabolism of calcium is provided below:

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**1. Glucocorticoid**

It is well recognised that glucocorticoids, like prednisone, accelerate bone resorption and decrease bone formation, which lowers bone mineral density (BMD) and raises the risk of osteoporosis and fractures. These drugs influence bone remodelling by suppressing osteoblast function and encouraging osteoclast activity. They also interfere with the gut's ability to absorb calcium and increase renal calcium excretion. [62]

**2. Diuretics Thiazide**

Thiazide diuretics, like hydrochlorothiazide, inhibit calcium excretion in the urine, which may help patients with osteoporosis or calcium deficiency, but they can also cause hypercalcemia in those who are predisposed to it. Increased calcium reabsorption in the kidneys can raise serum calcium levels. [63]

**3. Inhibitors of the proton pump (PPIs)**

By decreasing stomach acid, which is essential for the solubilisation and absorption of calcium, especially calcium carbonate, long-term usage of PPIs (like omeprazole) can hinder the absorption of calcium. A decrease in stomach acid might have an adverse effect on calcium solubility, which can reduce calcium absorption and possibly cause bone loss. [64]

**4. Bisphosphonates:**

By preventing bone resorption and boosting bone mineral density, bisphosphonates—like risedronate and alendronate—are used to treat osteoporosis. These medications work by binding to hydroxyapatite in bone to prevent osteoclast-mediated bone resorption, which preserves or increases bone density. Though their effects on bone turnover affect calcium homeostasis, they do not directly affect calcium metabolism. [65]

**5. Estrogen and Selective Estrogen Receptor Modulators (SERMs)**

In order to stop bone resorption and turnover in postmenopausal women, oestrogen and SERMs (such raloxifene) are utilised. In order to maintain calcium levels and bone density, oestrogen stimulates osteoblast activity while decreasing osteoclast activity [66].

**6. Calcitonin**

By inhibiting osteoclast activity and lowering bone resorption, calcitonin (including salmon calcitonin) helps control calcium levels. This hormone directly affects bone metabolism by lowering osteoclast activity, which helps to stabilise calcium levels and may be used to treat conditions like osteoporosis. [67]

**7. Antiepileptic Drugs (AEDs)**

AEDs that induce hepatic enzymes that result in enhanced vitamin D metabolism can impact bone health and calcium metabolism. Examples of these drugs are phenytoin and carbamazepine. Decreased calcium absorption and possible bone loss are caused by an increased metabolism of vitamin D. Osteoporosis and fractures may become more likely as a result. [68]

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**8. Anti-Resorptive Agents**

Drugs that block osteoclast activity and development, such denosumab, are used to stop bone resorption. In order to prevent osteoclast growth and function, denosumab targets and inhibits receptor activator of nuclear factor kappa-B ligand (RANKL) [69].

**9. Parathyroid Hormone (PTH) Analogues**

Osteoporosis is treated using PTH analogues, such as teriparatide, which promote the growth of new bone. By promoting osteoblast activity and boosting bone production, these substances work. Patients with severe osteoporosis can benefit from them by increasing their bone density and reversing bone loss. [70]

**CONCLUSION**:

By promoting bone health, assisting in osseointegration, and guaranteeing the stability and lifespan of dental prosthesis, calcium plays a varied function in prosthodontic treatments. The choice of supplement, including calcium carbonate, citrate, phosphate, or combos with magnesium or vitamin D, is determined by the specific requirements of each patient as well as the absorption properties and any adverse effects. For good oral and general health, calcium is essential.

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