

Role of Collagen Membrane in Alveolar Bone Grafting - A Review

Dr. Kartheek Chinthala^{1*}, Dr. Ibadur Rahman Khan², Dr. Anuradha Uttam Lokare³, Dr. Metla Subbaiah Naidu⁴, Dr. Vanka Aruna⁵, Dr. Vedatrayi⁶, Dr. Rahul Vinay Chandra Tiwari⁷

¹MDS; Consultant oral and maxillofacial surgeon, Kadapa, Andhra Pradesh, India

²Consultant Oral and maxillofacial surgeon, Family dental care, 4-3-116/1 pillar no. 123 Attapur, Hyderabad, Telangana, India

³MDS, Consultant Oral Pathologist, Mumbai, India

⁴Consultant oral and maxillofacial surgeon and implantologist, Indo American dental hospital, Yosufgoda Road, opp state home ammerpet, Hyderabad Telangana, India

⁵Consultant Periodontist, FMS Dental Hospitals, Hyderabad, Telangana, India

⁶MDS, Consultant Oral and Maxillofacial Surgeon, Tnagar Chennai, India

⁷FOGS, MDS, Assistant Professor, Department of Oral and Maxillofacial Surgery, Sri Sai College of Dental Surgery, Vikarabad, India

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*Corresponding author: Dr. Kartheek Chinthala

Abstract

One of the most notable congenital malformations in the head and neck include cleft lip, palate & alveolus. It may manifest as unilateral or bilateral and complete or incomplete. Reconstruction of the alveolar cleft is challenging and has ever remained controversial with regard to timing, graft materials, surgical techniques, and methods of evaluation. The primary goal of alveolar cleft reconstruction is to provide a bony bridge at the cleft site that allows maxillary arch continuity, oronasal fistula repair, eruption of the permanent dentition into the newly formed bone, enhances nasal symmetry through providing alar base support, orthodontic movement and placement of osseointegrated implants when indicated. In addition to these it also enhances speech, periodontal conditions, establishes better oral hygiene, and limits growth disturbances. In order to rehabilitate oral function in patients with cleft lip and or palate, alveolar bone grafting is necessary. Secondary bone grafting is the most widely accepted method for treating alveolar clefts. Literature shows that autogenous bone graft is the primary source for reconstructing alveolar cleft defects and is currently the preferred grafting material. However, it is believed that the use of a membrane in conjunction with an autogenous bone graft for alveolar ridge augmentation provides superior results. Hence, this paper reviews the role of collagen membrane in alveolar bone grafting.

Keywords: Collagen Membrane, surgical techniques, osseointegrated implants, alveolar bone grafting.

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INTRODUCTION

Clefts of the lip, palate, and alveolus are considered to be one of the most common congenital anomaly to affect the orofacial region [1]. These patients have an esthetic as well as functional imbalance. Repair of the cleft alveolus in particular is an adjunctive procedure to improve the social wellbeing of a patient with cleft lip and palate. It is generally recommended during the mixed dentition period [2]. Alveolar bone graft is considered to be an essential step in the overall management of a patient with cleft lip and palate [3]. Alveolar cleft bone grafting aids in facilitation of oral hygiene by modification of the complex morphology of the alveolar cleft, induction of canine eruption into the alveolar cleft, closure of vestibular fistulae, stabilization of the arch form during orthodontic treatment, creation of an alveolar bridge, and improvement in facial morphology by elevation of

the alar base [1]. Fresh autogenous bone is generally ideal for alveolar bone grafting since it provides living immunocompatible bone cells essential to osteogenesis for optimum osteoconductive, osteoinductive and osteogenic properties. However, it is associated with the need for surgery at donor site and the morbidity associated with it [4]. The use of xenografts have reduced the need for donor site morbidity. Materials like deproteinized bovine bone mineral (DBBM) & Bio-Oss collagen possesses osteoconductive and biocompatibility properties [5]. Recently collagen membrane is being used as a barrier membrane, where the blood clot and the graft are stabilized, and the epithelial and connective tissue cell migration is avoided, and slow migrating osteogenic cells can proliferate, resulting in new bone formation [6].

COLLAGEN MEMBRANE

Recently, the use of collagen membrane has gained popularity in guided tissue regeneration (GTR) and guided bone regeneration (GBR) [7]. Collagen membrane is a biocompatible membrane, made from types I and III collagen of porcine origin. GBR is a technique that works on the principle of separating particulate graft material from surrounding soft tissue to allow for bone regeneration, which occurs at a slower rate compared to soft tissues [8]. Collagen membranes are frequently used to stabilize the graft material, limit the graft resorption in addition to acting as an occlusive barrier toward the surrounding soft tissue regeneration and infiltration [9]. Bone resorption has been reported in cases where autografts are used without membranes. Therefore, membranes are utilized in nonspace making bone defects that require space maintenance and prevention of soft tissue ingrowth where bone regeneration is required [10]. Collagen-based membranes (CBMs) have similar permissive bone formation capabilities when compared to non-absorbable membranes [11]. They are classified as non-cross-linked membranes and cross-linked membranes depending on whether the cross-linking between the collagen fibers was artificially increased. The use of aldehyde and other chemical materials for covalent bonding has been referred to as chemical cross-linking. The natural behavior of the collagen membrane depends on the type of material used for cross-linking [12]. The amount and quality of the bone formed are similar regardless of the collagen membrane, but the exposure of the grafted bone to the oral environment during the healing period cause a negative influence which is prevented by the collagen sheet [13]. Collagen membranes are composed of collagen, which occupies majority of the normal tissue extracellular matrix, host immune cells, fibroblasts, and endothelial cells migrate through it and settle in and around it [14]. The use of collagen membranes in alveolar grafting has increased due to their high degree of biocompatibility and resorbable nature. Animal studies have shown it to be highly biocompatible, with no inflammatory cells collected at the site of surgery [15]. It is known that an autologous bone graft is replaced by new bone over a period of time. This remodeling process is slow in comparison to the regeneration and healing of the adjacent soft tissue. The membrane excludes the soft tissues, allowing remodeling to occur without any unwanted soft tissue ingress into the bony defects [7]. Collagen membrane degrades completely in 4 to 6 months after placement. Within this time, both soft tissue and bone get well integrated. In patients with cleft alveolus, this should ensure good bony integration of the underlying maxillary segment that is contiguous with an uninterrupted overlying palatal mucosa. This ensures that the recurrence of oronasal fistulas is extremely unlikely. In the absence of a membrane, if there was degradation of the bone graft, the ingress of palatal/nasal mucosal tissue can occur leading to the

establishment of oronasal fistula. It is therefore important that the entire bone graft be enclosed by the membrane to protect the bone graft during remodeling and incorporation into the cleft [7]. Verschueren *et al.*, analyzed the healed bone radiographically and histologically. This study showed that the membrane-covered defects had a significantly reduced defect area compared with the uncovered side. Histologically, the covered side was seen to have more organized osteogenesis and less fibrous tissue than the uncovered defects had. Histomorphometry revealed the membrane-covered sides to have significantly larger defect-area fill than the uncovered side [16].

TYPES OF COLLAGEN MEMBRANE

Collagen-based materials have often been used in alveolar grafting because of the desirable material properties of collagen like natural origin, rapid biodegradation rate, biocompatibility, etc. To decrease the degradation rate and enhance the temporal stability of collagen-based membranes, manufacturers have used several cross-linking approaches [17]. In spite of the fact that cross-linking may address membrane stability in the oral or wound environment, it may also result in compromised attachment and proliferation of desirable connective tissue wound cells which could lead to delayed wound healing and possible infection as well as to undesirable tissue reaction [15]. Alternative collagen processing and membrane manufacturing techniques have been developed which involves the combination of non-cross-linked native collagen III, which undergoes relatively fast degradation, and collagen I, which is more resistant, in order to tightly control membrane degradation [18]. The new non-cross-linked XCM is composed of collagen type I and type III without further cross-linking or chemical treatment. The XCM matrix is a bilayer: one side is thin and smooth and is of low porosity, while the other is a more porous 3-dimensional network. The XCM must be placed with the thin and smooth surface as the external layer since it is designed to allow cell attachment and host tissue integration but at the same time to remain impermeable to invading cells for 30 days. The more porous part is designed to be the internal layer since it is rapidly infiltrated by host mesenchymal cells [18, 19].

CONCLUSION

Literature has shown that the use of a resorbable collagen membrane in conjunction with an autogenous bone graft and inorganic bovine mineral (IBM) for alveolar ridge augmentation provides superior results. The treatment of vertically deficient alveolar ridges with guided bone regeneration using a mixture of autogenous bone and DBBM and resorbable collagen membrane can be considered successful, using this technique in an out-patient office setting.

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