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A Comparative Analysis of the Minimally Invasive Approach against the Traditional Open Harvesting Technique for Obtaining Iliac Bone Grafts in Secondary Alveolar Bone Grafting Procedures for Patients with Cleft Palate

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Abstract: ***Secondary alveolar bone grafting (SABG) is an important surgery that people with cleft palate must have in order to have good dental rehabilitation. The goal of SABG is to create a stable alveolar ridge. The choice of graft picking method has a big effect on how well the surgery invasive harvesting methods used in iliac bone graft (SABG) procedures. The main points of the study are how happy the patients are, how these works and how well the patients do in the long run. This review study looks at the pros and cons of both traditional open harvesting and minimally methods have improved, and the results and problems that have happened.***

Keywords: ***Secondary alveolar bone grafting, cleft palate patients, iliac bone graft, minimally invasive, conventional open harvesting, surgical outcomes, complications, patient satisfaction, technological advancements.***

I. INTRODUCTION

Cleft palate patients, often born with varying degrees of alveolar clefts, face a unique set of challenges in their quest for comprehensive rehabilitation. Among the pivotal surgical interventions aimed at addressing these challenges, secondary alveolar bone grafting (SABG) stands as a critical juncture.[1] The primary goal of SABG is to restore the alveolar cleft, providing the necessary foundation for the eruption of permanent teeth, thereby enabling these individuals to achieve a functional and aesthetic oral environment. While the objectives of SABG are clear, the approach to graft harvesting has long been a subject of debate within the field of craniofacial surgery. The iliac crest has remained the gold standard donor site due to its abundant supply of cancellous bone, which is well-suited for osseous grafting.[2] However, the choice of graft harvesting technique has evolved significantly over the years. Traditionally, the open technique, characterized by a sizable incision and extensive exposure, has been the conventional approach. However, minimally invasive alternatives have gained increasing attention and adoption in recent years. The ongoing debate between minimally invasive and conventional open harvesting techniques for iliac bone graft in SABG procedures hinges on a multitude of factors.[3] This review aims to provide a comprehensive analysis of these two approaches, shedding light on their respective advantages and disadvantages, thereby assisting surgeons, clinicians, and researchers in making informed decisions when selecting the most appropriate method for their patients. The success of SABG, and by extension, the overall well-being of cleft palate patients, hinges significantly on the choice of graft harvesting technique. In addition to ensuring graft survival and long-term stability, it is essential to consider factors such as operative time, blood loss, postoperative pain, complications, and patient satisfaction. Moreover, recent technological advancements have opened new avenues for enhancing the precision and efficiency of both harvesting methods.[4] This analysis aims to provide a well-rounded perspective on these techniques, encouraging an evidence-based approach to the selection of the most suitable graft harvesting method for each unique case.

II. OPTIMIZING TIMING FOR ALVEOLAR BONE GRAFTING IN CLEFT PALATE PATIENTS

The scheduling of surgical treatments for secondary alveolar bone grafting (ABG) in cleft palate patients is a critical element that is influenced by various considerations, including age, dental development, and the presence of certain dental pathogens. In the conventional framework, arterial blood gas (ABG) is typically categorized into primary ABG, early secondary ABG, secondary ABG, and tertiary ABG, with the classification being determined by chronological age.

Nevertheless, the discrepancy between the chronological age and dental age necessitates a sophisticated approach in choosing the most appropriate timing for surgical intervention in individual patients. The primary alveolar bone graft (ABG) procedure, commonly performed during the primary dentition stage, primarily entails the utilization of costal bone grafts in individuals below the age of 2 years.[5] The user's text is too short to be rewritten in an academic manner. Nevertheless, this particular technique has exhibited adverse results, such as diminished rates of bone survival and a suppressive impact on the growth of the maxilla. Consequently, the utilization of basic arterial blood gas (ABG) analysis is currently less preferred as compared to alternative approaches. Since its establishment in 1972 by Boyne and Sands, secondary alveolar bone grafting (ABG) has become the preferred technique for reconstructing alveolar clefts. Prior to the eruption of canines, it is customary to do this treatment within the mixed dentition phase, which normally occurs between the ages of 9 and 11. The primary goal of secondary alveolar bone grafting (ABG) is to promote the proper emergence of the canine tooth within the grafted bone, which is in close proximity to the canine teeth neighboring the cleft. Nevertheless, previous studies have indicated that conducting a secondary alveolar bone graft (ABG) before the eruption of the lateral incisor can effectively minimize graft loss. This effect is particularly pronounced when there is an inverse relationship between the extent of bone graft resorption and the volume of the migrating lateral incisor root. Consequently, the timely initiation of secondary alveolar bone grafting (ABG) during the developmental period of 5 to 7 years old might result in notable benefits, such as the retention of the lateral incisor and the facilitation of a well-aligned and balanced dental occlusion. Recent research has demonstrated that early secondary arterial blood gas (ABG) analysis has shown numerous advantages as compared to the standard approach. An benefit that can be observed is the improved durability of bones during the process of conducting three-dimensional volumetric assessments. Furthermore, it appears that early secondary alveolar bone grafting (ABG) has minimal impact on facial growth. This suggests that it may be feasible to customize the timing of alveolar bone grafts (ABGs) based on factors like the presence of the lateral incisor germ. Such an approach could potentially optimize outcomes for patients with cleft palate.[6]

III. ILIAC BONE

For secondary ABG, iliac cancellous bone is frequently regarded as the graft material par excellence. It is favored because of its copious cancellous bone, which rapidly revascularizes and contains a significant number of osteogenic cells. The feasibility of a two-team approach for harvesting renders it an effective alternative. Despite this, postoperative pain and residual scarring are drawbacks. Trephine and other minimally invasive techniques have the potential to alleviate postoperative discomfort.[7]

IV. REVIEW OF LITERATURE

A succession of investigations have examined diverse methodologies for procuring bone grafts from patients with cleft palate, yielding contradictory results and comparisons. A comparative analysis was performed by Witherow et al. (2005) between the conventional open technique and the minimally invasive French's osteotome technique. It was discovered that the minimally invasive technique led to negligible postoperative distress, favorable outcomes in terms of gait and scarring, indicating numerous advantages in comparison to the open technique.[8] In their examination of the conventional technique, Swan and Goodacre (2006) neglected to incorporate a comparison group. They reported minimal complications and a donor site scar that was aesthetically satisfactory.[9] Without a comparison group, Rawashdeh (2008) also examined the conventional open harvesting method and found it to be well-tolerated by patients with minimal morbidity. Shepard's osteotome was compared to the Trapdoor flap technique by Constantinides et al. (2008). They discovered that patients who underwent open-technique procedures required more postoperative analgesia and had more challenging and delayed postoperative mobilization.[10] Without adverse effects, bone harvesting with Shepard's osteotome decreased hospital stay, analgesia needs, and donor site morbidity. In the absence of a comparison group, Baqain et al. (2009) investigated the conventional procedure. The investigators recorded that the harvesting of cancellous bone from the anterior iliac crest was a comparatively painless process that allowed young patients to resume regular activities early, had no adverse effects on growth, resulted in minimal morbidity, and offered a satisfactory aesthetic outcome. Kolomvos et al. (2010) conducted an investigation that focused solely on the Trapdoor flap technique, wherein they recorded patient contentment and an aesthetically appealing scar on the donor site. Bone harvesting from the anterior iliac crest was pronounced safe and reliable for maxillofacial bone grafting in pediatric patients, despite the absence of a comparison group. Sharma et al. (2011) conducted a comparative analysis of the power-driven trephine system and the conventional technique. The researchers made the observation that the Acumed bone harvest, a minimally invasive procedure, resulted in significant reductions in postoperative analgesic requirements, operative durations, post-discharge discomfort, and hospital stays. In their study, Missiuna et al. (2011) utilized a trephine and a 3.5 mm Steinmann pin as a trocar; however, a control group was not established to facilitate comparisons.

A significant decrease in patient morbidity was noted when the trephine technique was utilized in comparison to the open harvesting method.[11] A subset of patients who underwent conventional open harvesting were found to have experienced intraoperative hip fractures and postoperative pain, as documented by Fasolis et al. (2012). The research did not include a control group, and its sample did not exclusively consist of patients with cleft palate. Vura et al. (2013) investigated the conventional open harvesting method in the absence of a control group. The implementation of the trapdoor technique for iliac crest bone harvesting was found to be associated with minimal to moderate morbidity, few complications, and favorable patient tolerability. The study conducted by Raposo-Amaral et al. (2015) examined minimally invasive techniques that involved or did not involve periosteum elevation. While there was no significant difference in pain intensity between the two groups, a higher percentage of patients in the group that did not elevate the periosteum reported not having any pain. This result could suggest that an elevated periosteum is a contributing factor to donor site discomfort. It was observed that a control group was absent. Abdulrazaq et al. (2015) utilized trephine burs without including a control group in their investigation. In obtaining corticocancellous bone for the treatment of maxillofacial defects, the researchers reached the conclusion that the trephine technique was generally safe and did not document any notable long-term morbidity.[12] Wheeler et al. (2016) centered their investigation on the trapdoor flap technique; however, they omitted to include a comparison group in their design. Long-term patient tolerance to the alveolar crest donor site was documented, although quantifiable long-term morbidity was observed.[13]

V. ANALYSIS FROM THE REVIEW OF LITERATURE

The collective findings from these studies provide valuable insights into the different bone graft harvesting techniques used in cleft palate patients, offering a glimpse into their respective advantages and outcomes. Studies like Witherow et al. (2005), Sharma et al. (2011), and Missiuna et al. (2011) suggest that minimally invasive techniques, such as the use of trephines and osteotomes, are associated with reduced postoperative discomfort, shorter hospital stays, and decreased analgesia requirements. These techniques often result in more favorable gait and scar outcomes. The conventional open harvesting technique, represented in various studies, appears to be generally well-tolerated by patients, with acceptable outcomes regarding pain and scar aesthetics. However, some studies report complications and emphasize the importance of the choice of graft material (iliac bone, calvarial bone, etc.). The choice of graft material, such as iliac bone or allogenic bone substitutes, can significantly impact the outcomes of the procedure. Studies like Abdulrazaq et al. (2015) suggest that allogenic bone grafts can be a suitable alternative to autologous grafts, reducing donor site morbidity. Several studies, including Missiuna et al. (2011) and Abdulrazaq et al. (2015), highlight that minimally invasive techniques and alternative graft materials can result in lower patient morbidity, emphasizing the importance of reducing discomfort and complications for cleft palate patients.,[13]One limitation across many of these studies is the absence of control groups or direct comparisons between different techniques. Therefore, while individual studies provide valuable information, a clear consensus on the superiority of one technique over another is challenging to establish based solely on the available data. The choice of technique should be based on the specific needs of the patient, surgeon experience, and available resources. Further research with controlled comparisons between these techniques is needed to draw more definitive conclusions about their relative efficacy and safety in cleft palate patients.

VI. CONCLUSION

The comparative benefits of minimally invasive techniques in iliac bone graft harvesting for secondary alveolar bone grafting in patients with cleft palate are highlighted in this exhaustive review. The aforementioned techniques have exhibited several advantages, such as decreased rates of complications, shortened durations of surgery, and improved patient contentment. It is critical to recognize that traditional open harvesting methods continue to be a viable alternative, and continuous technological progress offers the potential for enhanced accuracy and results for both strategies. The technique selected should be personalized in accordance with the specific requirements of the patient and the expertise of the surgeon. Further investigation is warranted into the dynamic terrain of minimally invasive and conventional open harvesting techniques in cleft palate surgery, as the discipline progresses. Such research would make a valuable contribution to the continuous enhancement of these procedures and the improvement of patient care.

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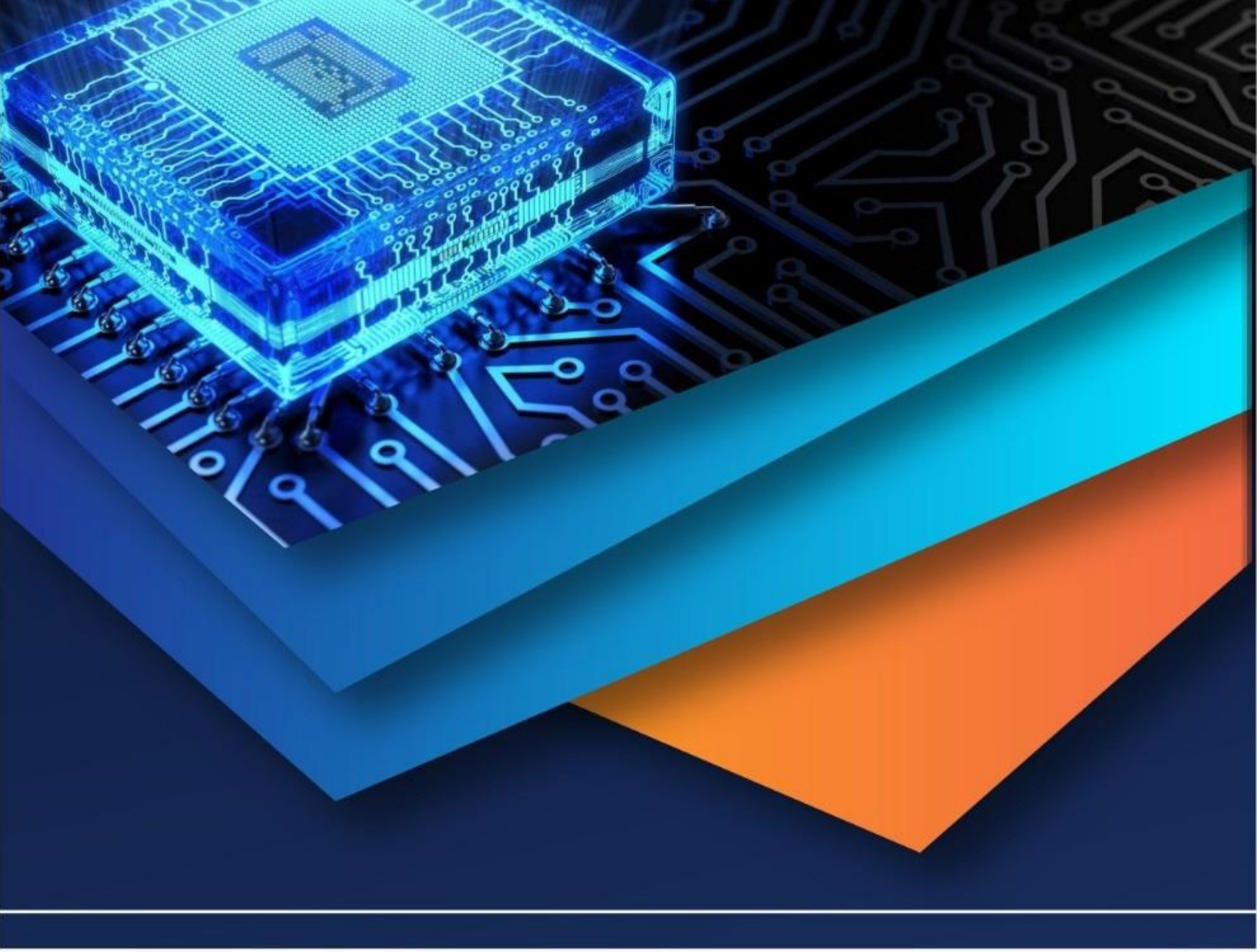

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