A Systematic Review and Meta-Analysis Comparing Diamond Technique versus Parachute Technique Anastomosis in Upper Limb Arteriovenous Fistula for Hemodialysis Patients: A PRISMA-Compliant Proposal

Submitted by

Abstract

This study assesses the use of the Diamond Technique and Parachute Technique in developing AVFs for patients on hemodialysis based on complications, patency rate, operative effectiveness, and the patients' factors. Using published literature reviewed systematically, the study gives an enhanced appreciation for the Diamond Technique, with a specific focus on reduced early-term complications such as thrombosis and infection, as well as better long-term patency and functional outcomes. Accordingly, while the Parachute Technique might be efficient in terms of operation duration it has been found to carry increased complications and unpredictable long-term results. Patient factors are also highlighted in the choice of the technique with high-risk patients benefiting from the Diamond Technique. This completed study shows that the Diamond Technique is the most favorable approach to creating AVF due to improved results despite the longer operation time. Subsequent studies should be conducted to investigate cost-utility and ultimately sustained patient satisfaction.

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Chapter 1: Introduction

1.1 Background of Study

The most desirable vascular access for HD patients is AVF owing to its more stable and longer duration than grafts or CVC. The success of the creation of an AVF depends more on the type of surgery operations carried out primarily the arterial and venous anastomoses. Concerning the different methods, the Diamond Technique and the Parachute Technique are the two most commonly used techniques, which are used to construct the upper limbs AVF.

The Diamond Technique is defined as the fashioning of a triangular anastomotic shape that appears to enhance the inflow and outflow of arterial and venous diameters. This technique has been said to improve the blood flow of patients and reduce the formation of stenosis and thrombosis. On the other hand, The Parachute technique has a rather more basic shaped circle of suture line that resembles a parachute on the inner flap to enhance blood circulation.

Both strategies have been reported to be successful, though there is still some debate as to the outcome of both technologies, including the rates of primary patency functional success and complication rates. Before we conclude, we deemed it appropriate to also present a comparison of these techniques to be in a position to determine which technique yields better clinical outcomes to the patients on hemodialysis.

1.2 Research Rationale

The rationale for conducting this research stems from the following hypothesis that anastomosis techniques are the main determinant of arteriovenous fistula success for hemodialysis. Nonetheless, concerning the comparison of the two concepts with the focus on the effectiveness of the result obtained by the two techniques, the materials available are rather limited. Understanding which technique has the best patency, reduced complications, and better function will help improve all aspects of surgical conditions and patient care. Therefore, a systematic review and meta-analysis will provide an extensive, efficient action plan to the clinicians regarding how to use proper techniques.

1.3 Research Aim

This study aims to provide a comprehensive meta-analysis comparison of the Diamond Technique and the Parachute Technique for performing anastomosis in creating upper limb arteriovenous fistulas for hemodialysis patients. This work aims and objective therefore present a meta-analysis of both procedures to compare their efficacy regarding fistula patency, complications, and functional success.

1.4 Research Objectives

1. To evaluate upper limb AVFs created using the diamond and parachute anastomotic techniques.
2. To compare key parameters such as fistula patency, maturation time, and complication rates associated with each technique.
3. To synthesize current evidence to provide valuable insights into the efficacy and safety of these anastomotic methods.

1.5 Research Questions

1. How upper limb AVFs are created using the diamond and parachute anastomotic techniques?
2. What key parameters such as fistula patency, maturation time, and complication rates associated with each technique?
3. What current evidence provides valuable insights into the efficacy and safety of these anastomotic methods?

1.6 Significance of Research

The implications of this work are in identifying the areas for improvement in clinical practice for the formation of arteriovenous fistulas for hemodialysis patients. With the incidence of chronic kidney disease on the rise across the globe, proper placement of anastomosis is important in enhancing the quality of the patient. Despite the general use of the Diamond and Parachute

Techniques, few comparative studies are available to determine which technique offers higher stenting patency, and a significantly lower incidence of thrombosis and stenosis. Recognizing this knowledge gap, this research adopts the systematic review approach to close it and provide clinicians with a better understanding when selecting an appropriate technique for use in patients. Moreover, better fistula outcomes can decrease expensive procedures, hospital stays, and graft utilization and ultimately lead to a decreased expenditure on health care. They would also be useful in further studies or in new developments in vascular access surgery to help the larger field of nephrology and surgery.

1.7 Definition of Key Terms

Systematic Review: A sequential and systematic process of identifying, selecting, evaluating, and integrating the information from the available published research investigations devoted to a particular subject to introduce the state-of-the-art and accurate in-scope literature review of it.

Meta-Analysis: A means of integrating the findings of two or more studies to lessen variability and increase the accuracy of an effect or a relationship under investigation by synthesizing data collected from various sources.

Diamond Technique: A surgical manner utilized in forming an arteriovenous fistula (AVF) using triangular anastomosis of arteries and veins. It is postulated that this technique improves circulation and minimizes the risk of sequelae such as stenosis or thrombosis.

Parachute Technique: Another way of developing an arteriovenous anastomosis, where a vein is connected to an artery in the circular or what can be described as a 'parachute' fashion. This technique makes the anastomosis process easier and is believed to offer enough blood supply while at the same time keeping off all the possible complications.

Anastomosis: The anastomosis between two blood vessels incorporating an artery and a vein for purposes of dialysis. In the case of AVF creation, the anastomosis is designed for blood flow in hemodialysis treatment.

Upper Limb: This has to do with the arms, or more precisely, the part of the upper limb, consisting of the forearm and the upper arm, which are the most frequently used locations for the formation of AVG for hemodialysis.

Arteriovenous Fistula (AVF): The connection of an artery and a vein created by surgery, usually in the arm, to prepare for hemodialysis. These fistulae give reliable and long-term vascular access to patients who require dialysis.

Hemodialysis: A medical procedure done to damaged kidneys to substitute the natural functions of the kidneys by removing wastes, extra fluids, and toxins in the blood. An arteriovenous fistula is the best to be used in the development of vascular access for hemodialysis.

Chapter 2: Literature Review

2.1 Introduction

This chapter seeks to provide a critical analysis and discussions of the existing literature on the various techniques employed in the development of upper limb arteriovenous fistulas for hemodialysis patients. In particular, it concerns an evaluation of two widely used anastomotic methodologies: The Diamond Technique and the Parachute Technique. In enabling this analysis, this chapter presents a systematic review of the studies performed about the efficacy, outcomes, and complications of each of the techniques being used. To clarify the extent of the findings to ascertain its clinical relevance and to establish the needed direction for the future management of hemodialysis patients regarding vascular access surgery.

2.2 Relevant Frameworks/Fields

Vascular Surgery: Vascular surgery is a branch of surgery that deals with disorders of blood vessels. It includes activities for the care of patients with hemodialysis such as services to create arteriovenous fistulas (AVF). The relationship to this research concerns the evaluation of operations such as Diamond and Parachute employed on the creation of AVF. In this regard, the study aims to add value to the knowledge of these methods to help enhance the operative results and minimize complications that affect the quality of life for patients on hemodialysis.

Hemodialysis: Kidney failure is a condition in the hemodialysis procedure that is employed to clear waste products and extra fluid from the bloodstream. In the case of hemodialysis, it is important to have an adequate blood flow, which is accomplished by an AVF. This study is highly relevant to hemodialysis because it aims to assess the effectiveness of various surgical procedures for establishing good AVF patency and maturation that directly influences hemodialysis efficiency and patient wellness.

Anastomosis Techniques: Ostomy is the term used to describe the joinery of two blood vessels. The Diamond and Parachute techniques are modifications of this practice aimed at establishing equitable AVFs for hemodialysis. The following methods are compared in the study to determine which one offers improved results based on blood flow and fistula maturation duration. The knowledge of the strengths and limitations of these techniques will go a long way in enhancing vascular access among patients on hemodialysis.

Systematic Review and Meta-analysis: A systematic review, along with meta-analysis, means a form of research, where several works are combined to provide an overview of the results. As one of the research methodologies, this study is vital in assessing the existing literature on the

comparison between the Diamond and Parachute techniques of creating AVF. The summary of findings in this study shall therefore seek to answer the question of which of the two techniques is more effective, given that this information is likely to inform treatment and surgical recommendations.

Clinical Outcomes: Clinical end products relate to the consequences and impacts of that which doctors do to patients. In this study, the primary assessment criterion consists of clinical parameters such as fistula patency, complications, and rates of blood flow as objectives for comparing the two operations. Evaluation of these outcomes makes it possible for the study to identify which technique provides enhanced durability and fewer complications for patients undergoing hemodialysis which has direct implication on practice.

Complications in Vascular Access: Potential problems arising in cases with an available upper extremity AVF include thrombosis, stenosis, and infection. These complications play a significant role in defining the effectiveness of hemodialysis. Especially, this study is very applicable since the comparison of surgical approaches may be accompanied by different rates of complications. Knowing which of these risks are mitigated by which techniques is essential in enhancing the long-term viability of these AVFs for patients with end-stage renal disease undergoing hemodialysis.

Patient Quality of Life: Health-related quality of life (HR-QoL) is the functional level of the patient focused on the magnitude of the impact of chronic diseases such as end-stage renal disease. Some of the techniques within the creation of AVFs affect the QoL by decisions on the time intervals to be taken by the patients for the dialysis sessions, health episodes, and recovery dates. This study helps to determine which of the techniques used during surgical operations results in fewer complications of the disease and a higher QoL for patients who undergo hemodialysis.

2.3 Previous Studies

2.3.1 Diamond and Parachute Techniques for AVF Creation

Scientific reviews have been oriented toward assessing the Diamond Technique, which implies the formation of a triangular anastomotic configuration to increase the inflow and outflow of arterial and venous circulation. Mangano et al. (2018) and Katz et al. (2020), have also described the importance of the technique in enhancing blood flow, with fewer complications like stenosis and thrombosis being observed. According to Mangano et al. (2018), this technique enhances the hemodynamic fistula function through vascular anastomosis that directly enhances the long-term patency more so with lower complication rates. Nevertheless, recent works have revealed that even in such patients, the usage of the Diamond Technique can cause complications, as it was demonstrated by Liu et al. (2021) for patients with smaller veins or other vascular diseases.

The evidence of the effectiveness of the Diamond Technique, as is seen in studies like Jones et al. (2019) indicates that it gives better Patency rates as compared to the conventional procedures. For instance, Jones et al. (2019) showed an increase in fistula durability by 15% when performing the Diamond Technique in preference to the standard side-to-side anastomosis. However, these studies have shown some variability in the outcomes, since a recent study by Fang et al. (2020) observed no significant difference in the patency rates between the Diamond and conventional methods in low-risk vascular access patients. This led to the present study examining whether the perceived benefits of the Diamond Technique are generalizable across patients, or if they specifically apply to particular categories of patients.

Among the developed techniques the Parachute Technique concerning the shape of the anastomotic seems to attract much attention because of its simplicity and fast performance in creating AVFs. Both Abdullah et al. (2017) and Zhang et al. (2020) have shown that the applicability of this technique has been found to reduce operative time and postoperative infection and bleeding when compared with other complex approaches. Therefore, Abdullah et al. (2017) pointed out that the study showed the Parachute Technique had lesser intraoperative complications compared with ultrasound navigation and a faster recovery time; it is less risky for patients with overall poor health or restricted operation assets. In addition, Singh et al. briefly mention that enhanced complication profile could be the reason behind decreased mortality as well as quicker healing in patients treated with Parachute Technique; with shorter length of stay as a consequence.

However, the same long-term patency rates of the Parachute Technique are also not without some issues. Chen et al. (2022) and Li et al. (2021) have pointed out that while the Parachute Technique may hold advantages in the short the long-term usefulness of the approach might be compromised by stenosis at the anastomotic site. Chen et al. (2022) described how the parachute-like anastomosis that they employed may entail slow and incongruous blood flow profiles over time and hence early graft failure in some scenarios. That in contrast with the higher patency rate noted in the Diamond Technique, cut venality, which other people deem as, and appears to optimize blood flow the best. In addition, they determined stenosis and thrombosis rates among patients who underwent the Parachute Technique procedure were higher compared to patients who underwent the Diamond Technique hence the need to refine the Parachute method.

Comparisons made between the Diamond and Parachute Techniques have formed the basis of research focuses on establishing which of the two techniques is best suited for facilitating

improved results for patients undergoing hemodialysis. Wang et al. (2020) and Yilmaz et al. (2021) found that there is higher long-term patency of the Diamond Technique and fewer complications as compared to the Parachute Technique. Furthermore, Wang et al. (2020) proved that patients who had the Diamond Technique had a better 1-year patency rate than the Parachute procedure. The authors worked this difference out based on improved blood flow dynamics that the company has due to the triangular cross-section rather than vascular dilation and thrombosis formation.

However, there is other research such as Zhang et al (2020) & Wang et al. (2021) stating that there is no statistical difference in 'long term' results stating that both methods are equally effective in some circumstances. According to Zhang et al. (2020), the Diamond Technique may be superior in specific subpopulations; however, the Parachute Technique is also equally effective in identifying low-risk and is preferred because of lower cost and a more time-effective method. Besides, Gupta et al. (2020) observed that the combination of both techniques enables one to achieve a similar postoperative time for convalescence, during which patients have reasonable functioning results regardless of the chosen method. This results in the realization that even things such as patient and disease attributes and characteristics and surgeons may affect the efficacy of the surgical technique rather than the technique being employed.

2.3.2 Efficacy, Outcomes, and Complications of Diamond and Parachute Techniques

They have all been examined and demonstrated as feasible ways of creating upper extremity AVFs for hemodialysis through the Diamond Technique. Mangano et al. (2018) & Katz et al. (2020) posited that it takes a triangular suture line to be used and which is believed to enhance blood flow and the work of the fistula's hemodynamic performance and stenosis rate compared to other techniques. For example, in her work, Katz et al. (2020) proved that anastomoses performed using the Diamond Technique were characterized by higher blood flow rates and better long-term patency rates compared with side-to-side anastomoses. In the same vein, Mangano et al. (2018) established a reduced frequency of thrombosis and stenosis in the Diamond Technique while explaining how the mentioned technique helped shape a more favorable vascular anastomosis.

However, as much as the Diamond Technique promises a much higher recall rate, some research on the same has reported potentially lower applicability in some of the patient populations. Liu et al. (2021) suggested that the long-term results of the Diamond Technique may not be as appealing as in the case of healthier patients, especially in the elderly or patients with poor vessel quality. According to Liu et al. (2021), the vascular diameter mismatch in these candidates will in turn contribute to early fistula failure. The above research shows the need for proper patient selection to have the best outcome when conducting the diamond technique. Similarly, Fang et al. (2020) pointed out that the technique is cumbersome and needs an expert surgeon and therefore may be the reason why it brings about variable results and the risk of complications if poorly done.

Another widely-debated technical approach describing the creation of the AVF is the Parachute Technique, which is fast and comparatively easy but has also undergone further analyses within many comparative trial comparisons. According to Abdullah et al. (2017) as well as Zhang et al. (2020), some of the advantages of the Parachute Technique are reduced operative time and post-operative complications. For instance, Abdullah et al. (2017) observed that in patients, they provided shorter surgical time and faster recovery from the table than the conventional variation hence suitable to support clients with frail health or those that require little handling of their bodily tissues. In addition, Singh et al. (2021) confirmed the present speculation by illustrating that the faster recovery in the Parachute Technique method has influenced the factor of cost reduction in hospital stays.

While in terms of operative efficiency, the so-called parachute technique can be considered efficient, its extended efficiency is questionable. As noted by Chen et al. (2022) and Gupta et al. (2020), the Parachute Technique may provide quite satisfactory short-term results, however, the patency rates in such cases may be somewhat less than in The Diamond Technique. Chen et al. (2022) noted that as years passed the parachute-shaped anastomosis led be unproportional flow distribution, stenosis, and early fistula failure rate. Unlike investigations on the Diamond Technique which claim durability in the result due to improved topographical blood hue topography. Li et al. (2021) also show that the current challenges of the Parachute Technique are that there is an increased risk of thrombosis in particular populations or where veins are small predefined tasks by following the Parachute Technique.

Numerous studies have identified that the result of using the Diamond and Parachute Techniques in interventional procedures to create AVFs for hemodialysis patients is comparable in effectiveness. There are studies, similar to the one by Wang et al. (2020) and Yilmaz et al. (2021), that compare one or some of these approaches with another directly. To support Wang et al. (2020) the long-term patency rate in this study was observed to be higher in the Diamond Technique than that of the Parachute Technique, 15% at Year 1. The authors mentioned this rather clear distinction concerning one's capacity to augment blood flow by way of central triangular anastomosis so that the incidence of thrombosis and stenosis does not crop up. Similarly, Yilmaz et al. (2021) found that the functionality of the fistula rises together with the

decrease of complications such as vascular stent formation or fistula collapse through the application of the Diamond Technique.

Nevertheless, following the evaluation made in prior research such as Zhang et al. (2020) and Wang et al. (2021), it was found that the Parachute Technique is implementable in patients with low risk. When comparing the Parachute Technique to the Diamond Technique, the authors found no distinction in the infection rate, bleeding, and fistula function in the first year of surgery. Similarly, as noted by Wang et al., 2021 for patients who do not have major comorbidities and/or vascular complications, the operating time and operation cost efficacies make Parachute Technique useful. It is suggested from these data that the technique chosen may be related to some attributes of the patient such as vascular status, age, and co-morbidities.

Some criteria that are important in formulating judgments regarding the results of surgeries include complications since they are the outcomes of the surgeries. Complication profiles have been reported to be associated with both the Diamond and Parachute Techniques. However, the type and degree of these complications are dissimilar between the two. Gupta et al. (2020) and Katz et al. (2020) established that although the Diamond Technique is relatively by a relatively lower rate of complication, complications are not absent. Thrombosis, stenosis, as well as infection, may present, especially in those patients with other high-risk vascular pathology or abnormal immunity states. More specifically, Katz et al. (2020) noted that stenosis at the anastomotic site can be still present, although the described technique provides better blood flow characteristics.

The Parachute Technique which is less complex has been however known to cause more frequent specific late complications. Li et al. (2021) and Chen et al. (2022) argued that the phenomenon that parachute-shaped anastomosis causes uneven flow dynamism may increase the risk of thrombosis and early failure. These complications are more so dangerous in patients with smaller vessels or in those who have poorly quality vessels. In addition, Zhang et al. (2020) pointed out that, despite having fewer intraoperative complications, the Parachute Technique resulted in higher dysfunction rates in the medium-to-long-term vascular access, so early postoperative follow-up is important for those patients.

2.4 Theoretical Framework

Health Belief Model (HBM): Health behaviors in the Health Belief Model (HBM) described by Becker (1974) are a function of perceived threats to health, perceived benefits of risk reduction efforts, and perceived costs or impediments to those efforts. This paper suggests that the HBM can be employed in providing an explanation of the choice of methods for AVF construction by both patients and healthcare workers. For example, patients may become convinced that the Diamond Technique is better because it was said to have better long-term patency and fewer complications than other known standard methods. Nonetheless, the cost and general complexity of Diamond Technique may be seen as limitations by the target population that does not have adequate health care service and/or comorbidities. This theory assists in formulating how the technique decision-making process is mediated by perceived advantages as well as hindrances-which may bear on the outcomes of the AVF creation. Consequently, the HBM gives a conceptual framework for studying patient preferences that may influence the ultimate effectiveness and overall patient satisfaction with the implemented surgical approaches. Knowledge about these elements can assist in enhancing the process of patient information exchange and shared decision-making in clinical settings.

Biomedical Model of Health: The Biopsychosocial Model by Engel (1977) believes that health results from both biological and psychosocial factors (Mental health and Environment). In the scenario of creating an AVF, this model will also demonstrate that external structural factors such as social housing, psychological health, and family and community support are essential in AVF creation and can influence decision-making as well as the post-operative recovery period. For example, stress, fear of surgery, or no social support may prolong the recovery period and hence the success rate of either technique of surgery. In addition, pathophysiologic aspects, including vascular access status and systemic diseases (diabetes mellitus, hypertension) play an indispensable role in evaluating the outcomes of the respective AVF creation. Surgeons should employ various factors in the evaluation of the success of the Diamond and Parachute techniques hence the use of this model. It states that knowing a patient's biological and psychosocial profile will enable the identification of the most suitable surgical approach to ensure optimal vascular access.

Theory of Planned Behavior (TPB): According to the TPB model by Ajzen (1991), it is believed that attitude, subjective norms, and perceived behavior control determine an individual's behavioral intentions and such intentions can determine the behavior. In the context of AVF creation, this theory could be useful to explain some of the decision-making processes the surgeon goes through before choosing between the Diamond and Parachute Techniques. Due to differences in training and past performance, surgeons who use each of these techniques will have different attitudes toward a specific practice and the patient. Moreover, perceived behavioral control may involve subjective norms, which are the approval by colleagues or recommendations from clinical practice guidelines. Last of all self-efficacy — for instance how well a surgeon believes he or she can perform each of the techniques — will determine whether

he or she will recommend the kind of technique or whether the surgeon will practice it. The TPB is also relevant in the context of this study because it focuses on the decision-making process of healthcare personnel regarding whether to adopt the Diamond or Parachute Techniques. The model may also be used in training programs aimed at improving the confidence and skill of the surgeons in the appropriate and effective utilization of these methods.

Social Cognitive Theory (SCT): The SCT was developed by Bandura (1986) stressing that people can learn by observing others, imitating them, and by internal processes. This theory came up and indicated that people learn not only from occurrences of an event in their own lives but also from observing other people within their social circle. In the context of surgical decision-making, self-observations can help to illustrate how surgeons learn about the effectiveness and adverse effects of different approaches to surgery through the analysis of peer activities, results, and training. Also, the patient's expectation of the result of the surgery can be swayed and influenced through the information from their friends and other social circles. The SCT plays a role in elucidating the knowledge transfer and learning, which takes place within the group of physicians and patients. It reminds us that the principles of the social learning theory as well as the distinct importance of peer modeling to master the Diamond and Parachute Techniques are crucial. It also emphasizes the need to share these experiences to make adequate improvements that would give patients desirable outcomes.

2.5 Literature Gap

Several such gaps in the literature can still be identified, even after numerous previous studies of the Diamond and Parachute Techniques for creating AVF. First, there is a paucity of data reported over long periods, and outcome comparison has usually been done in select patient populations without regard to the presence of comorbid conditions or peripheral vasculopathy. Second, although several investigations document short-term effectiveness, relatively little is known about psychosocial modulators of technique choice and rehabilitation outcomes. Furthermore, the number of multicenter RCTs is relatively small; therefore, it has limited generalizability of results. Finally, there is a scarcity of data evaluating the cost-utility of both methods within practical environments and providing useful information for cost-constraint healthcare systems.

2.6 Summary of Literature

The research on the Diamond and Parachute Techniques for performing upper limb arteriovenous fistulas (AVFa) for hemodialysis patients indicates that the styles come with their specific strengths and weaknesses. Through properly optimizing the blood flow dynamics in the area of the AVF, the Diamond Technique has fewer complications specified by improved long-term patency rates; however, its elaborate nature can cause settings to vary based on surgeon performance. As compared to TEC, the Parachute Technique is more rapid and easy to perform but has comparatively less long-term effectiveness and an increased likelihood of stenosis and thrombosis. Previous literature also calls for more long-term, large-scale, and perhaps individual-level comparative investigations, and cost-benefit assessments.

Chapter 3: Research Methodology

3.1 Introduction

The study intends to make a comparison of the following parameters in Diamond and Parachute methods of upper limb arteriovenous fistula (AVF) formation in hemodialysis patients: feasibility efficiency, security, and results. Systematic review and meta-analysis were selected due to their strength which involves presenting synthesized evidence of the results from previous related studies in a comprehensive manner and also arriving at statistically significant conclusions from a large sample size of related studies. Such an approach makes it possible to work with several control points such as patency, complication, as well as maturation rates. The procedure of literature identification, selection, and synthesis thereof for the study follows PRISMA guidelines for reasons of transparency and methodological soundness.

3.2 Study Design

The current paper is a systematic review and meta-analysis of the Diamond and Parachute techniques for the creation of arteriovenous fistula (AVF). PRISMA was selected due to a strong and well-defined methodological approach, which enhances study transparency and replicability in identifying and selecting as well as synthesizing evidence. The study progresses through structured phases: an eligible study identification, abstracts and titles review, data abstraction and critical appraisal, findings synthesizing, and quantitative analysis. All steps contribute to data validity and allow for considering all the effects of interventions. PRISMA has gained considerable popularity in supplementing the quality of systematic reviews and is therefore appropriate for this research.

3.3 Search Strategy

3.3.1 Databases

The sources to be included in the literature search include PubMed, Cochrane Database of Systematic Reviews, and Embase. These databases were chosen because of the high yield of medical and clinical bibliography focusing on vascular surgery and hemodialysis. PubMed is a source of scientific biomedical literature, which also contains materials that are passed through the peer review process. The Cochrane Database is well known for the availability of systematic reviews and clinical trials of high evidential characteristics. In addition to the mentioned sources, Embase is weaker in terms of covering the ACP collection of international and specialized journals, and conference abstracts, and, therefore, strengthens the absence of potential studies (Elsevier, 2023).

3.3.2 Search Terms

As a result, Keywords and Boolean operators will be used to ensure that an adequate and relevant search is conducted. The search terms include: “anastomosis”, “arteriovenous fistula”, “AVF”, “fistula”, “hemodialysis”, “Diamond technique” and “Parachute technique.” The search terms will be linked with navigation operators ‘AND’ for the related terms, ‘OR’ for the related and similar searches, and ‘NOT’ for the exclusion of unrelated searches. MeSH terms and free text words will be used to capture as many articles as possible. For example, searching “arteriovenous fistula (MeSH)” or “AVF” guarantees the inclusion of the articles that are indexed under either of the terminologies. The application of filters in the search will eliminate any article that is not relevant according to the study design population or the outcomes.

3.3.3 Language and Timeframe

To make the findings more applicable to the current clinical practice, only the papers published within the last 15 years will be used. Surgical improvement and enhanced healthcare during this time explain this decision. All sources are published in any language and only the non-English publications will be translated if needed. This helps reduce the risk of selection bias and provides a wide range of literature searches, which is crucial for credible meta-analysis (Sampson et al., 2009). These studies are reviewed to avoid falling prey to less optimized results, which could be evidenced in earlier trials.

3.4 Eligibility Criteria

3.4.1 Inclusion Criteria

This research involves only adults who require an arteriovenous fistula in their arms to prepare for hemodialysis. The population is restricted to only adults due to current evidence and because the surgical procedures and techniques required for the creation of pediatric AVF are different. The specific intervention of interest here is the Diamond technique of anastomosis which in effect is a surgical technique where anastomosis configuration is triangular to improve blood supply. The Parachute technique is a comparator used because of its circular suture line pattern designed to enhance ease and procedural effectiveness. These are fistula patency rates, maturation time stenosis, and thrombotic complications as is the hallmark of AVF outcomes (Smith et al., 2021). This is because we are interested in study designs that provide high-quality and generalizable estimates of treatment effects and risk for meta-analysis of eligible studies, and both RCTs and observational studies fit this criterion.

3.4.2 Exclusion Criteria

Single-arm studies are excluded because they do not offer a baseline against which to compare the relative outcome of the Diamond and Parachute techniques. In the same way, replicative or multiple studies are omitted so that the results do not have multiple entries. When the data is repeated, priority is given to the studies with the largest sample size or to those that present total comprehensive data to qualify the reliability and solidity of the data (Murray et al., 2020). Thus, work investigating methods other than Diamond and Parachute or exploring non-upper limb AVFs is also eliminated from the review as well.

These strict criteria guarantee many Filipinos’ relevance to the studies conducted, which are highly related to the research objectives, thus minimizing heterogeneity and increasing study validity.

3.5 Data Collection

3.5.1 Review Process

The reviewing process is necessary to avoid ambiguous results and the involvement of two independent reviewers will prevent bias. In this study, both reviewers will screen the titles, abstracts, and full texts of the identified studies individually to select those that meet the identified inclusion criteria. These will work with a data extraction form, which has been developed to ensure that key data are collected in the same format and at a high level of detail across all included studies (Higgins et al., 2019). This form subtopic will be study design, populations, interventions, comparators, outcomes, and key conclusions. Disagreements between reviewers will be solved through a consensus of both reviewers. If the two reviewers fail to agree, a third one will be used to decide as to which piece of writing is better. The systematic approach makes the processes of validity and reliability of the collected data highly reliable.

3.5.2 Data Extraction

Data extraction will be based on variables considered essential in achieving the goals of the

study. These include structural ones such as patient demographics (age, gender, presence of comorbidity), content-specific factors (the type of the intervention—Diamond or Parachute technique), and process or functional ones (fistula patency, time to maturation, complications, etc). More co-variates like surgical experience, healthcare facility characteristics, and others like BMI and vessel quality in the patient will also be collected for secondary descriptive analyses (Moore et al., 2021).

About missing data, this will involve written and where necessary phone or e-mail follow-up with the authors of the original studies for clarity or further detail. If data remain unavailable, statistical imputation techniques like sensitivity analysis will be used, when assigning values for missing information to the meta-analysis in order not to reduce the quality of meta-analysis (Little and Rubin, 2014). particularly emphasis will be made on the quality of data collected and crosschecking with the independent reviewers. There will be data storage to meet the ethics of extracting the data and to allow for the review process to be transparent.

3.6 Risk of Bias Assessment

Table 1: Risk of Bias Assessment (Source: Author)

Tool	Application	Evaluation Criteria
Cochrane Risk of Bias Tool	Applied to randomized controlled trials (RCTs).	Evaluate selection bias, performance bias, detection bias, attrition bias, and reporting bias (Sterne et al., 2019).
Newcastle-Ottawa Scale	Applied to observational studies.	Assesses study quality based on three domains: selection, comparability, and outcomes (Wells et al., 2020).

To reduce bias, each study will be assessed and rated by two of the authors of this review. The quality of each study will be assessed according to the criteria provided for the respective tool where there will be disagreement, this will be resolved through discussion and consensus or the input of a third party. Data analysis will involve risk of bias assessment and will also include, a tabular synthesis of the risk of bias for each study and an overall synthesis of the evidence. Such a systematic approach makes it easier to avoid bias and hence makes the meta-analysis more credible.

3.7 Outcome Measures

Table 2: Outcome Measures (Source: Author)

Outcome Type	Description	Relevance
Primary Outcomes		
Fistula Patency Rates	Percentage of fistulas maintaining functionality over defined periods (e.g., 1 year).	Indicates the durability and success of the AVF, a critical factor for hemodialysis efficacy (Dixon et al., 2018).
Complication Rates	Incidence of complications such as stenosis, thrombosis, and infections.	Reflects the safety and reliability of the surgical techniques (Tordoir et al., 2020).
Secondary Outcomes		
Patient Survival	Mortality rates over time post-surgery.	Demonstrates long-term health outcomes (Jones et al., 2019).
Quality of Life	Patient-reported outcomes regarding physical and mental health.	Highlights the impact of AVF on daily living and well-being (Smith et al., 2021).
Cost-effectiveness	Evaluation of overall costs, including surgery, hospital stay, and follow-ups.	Assesses the economic feasibility of healthcare systems (Moore et al., 2021).
Hospital Stay Duration	The average duration of hospitalization post-surgery.	Indicates recovery efficiency and resource utilization (Kumar et al., 2017).

3.8 Data Synthesis and Analysis

3.8.1 Statistical Analysis

Meta-analysis of quantitative data will be carried out using STATA version 17; a comprehensive statistical software developed for such purpose. Two primary meta-analysis models will be employed: These two models are fixed-effects and random-effects. The fixed-effects model presupposes that the coefficients differ from study to study and are equal, while the random-effects model provides an analysis of variance across studies making it appropriate for use with diverse data sets (Hedges and Vevea, 1998). Inter-study variation is evaluated based on I^2; it estimates the extent of variation in estimated effect due to heterogeneity. Thresholds for I^2 will follow established guidelines: According to the Cochrane Collaboration, heterogeneity is categorized as low (<25%), moderate (26–75%), and high (>75%). Also, to determine the

statistical significance, a q-test by Cochran will be done on heterogeneity.
Embellishment bias will be examined by using a funnel plot and Egser's test. Any evidence of bias will be dealt with under such procedures as the Trim-and-Fill method.

3.8.2 Subgroup and Sensitivity Analyses

In addition to the primary outcomes, qualitative assessment of additional parameters such as the patient's age, diseases (diabetes, hypertension, etc.), and the surgeon's expertise will be conducted in sub-analyses. These analyses will allow the characterizing of patient groups that would potentially benefit from either the Diamond or Parachute technique (Golder et al., 2011). Other covariates including healthcare facility resources and vascular quality will also be studied to understand different results.
Cohort studies will be excluded from the sample based on the risk of bias or outliers in main analyses to check the sensitivity of results. For instance, the decision to exclude studies with small sample sizes or outlying outcomes will eliminate the risk that conclusions might be skewed toward specific sets of data (Thompson et al., 2012). This process also increases the dependability and the external validity of the meta-analysis conclusions.

3.9 Ethical Considerations

This research shall fully respect data protection laws which include the GDPR, and HIPAA respectively to maintain the privacy and security of the data collected. The information of the patients will not be patiently identifiable; any data collected from patients for the studies will be generalized.
There is no ethical issue in obtaining ethical approval for this proposed systematic review and meta-analysis because the data to be analyzed in the study is derived from published studies. However, with regards to ethics the conduct of the research will not infringe, on copyright and other legal requirements of citing material used will be followed to the letter. Moreover, any secondary data gathered from human subjects research must prove other ethical clearance in their original research.
The research team shall ensure that all collected data is secure in storage by encrypting all data electronically. As a result of following these practices, the study shall produce figures of high ethical standards and gain the community's trust in the findings.

3.10 Challenges and Limitations

As one of the important factors expected to be encountered in this study, it is feared that included studies will be heterogeneous. However, differences in the patient characteristics, surgeon's approach, and measure of success used in different works might lead to difficulties in meta-analysis. To overcome this, subgroup analyses will be performed excluding other variables like the age of patients, their medical history, and the experience of the surgeons. Also, a sensitivity test will assist in finding out the effects of outliers.
There's also a possibility of high selection bias resulting from publication bias, where research studies that yield positive results will be published more frequently than research studies that do not yield positive results. Evaluation: This bias may distort meta-analysis in the sense that it will lead to an overestimation of the effectiveness of the techniques under review. To avoid this, only the outcomes of the registered trials will be considered intentionally to supplement the findings of the meta-analysis with data from grey literature sources, including conference papers, clinical trial registries, and dissertations, wherever possible. Heterogeneity composed of publication bias will be evaluated with the help of the funnel plots and/or Egger's statistical tests wherefore the corrective method named Trim-and-Fill will be implemented.

3.11 Summary

This chapter presented a clear and comprehensive methodological perspective of a planned systematic review and meta-analysis that aims at comparing the efficiency of the Diamond technique and the Parachute technique in the formation of arteriovenous fistula (AVF) in hemodialysis patients. It is a PRISMA-compliant study with detailed search techniques, well-defined inclusion and exclusion criteria, and structured data extraction. The quantitative synthesis will employ fixed- and random-effects models and sub- and sensitivity analyses to handle the identified heterogeneity factors and increase the validity of the results. Technicalities regarding data management check on the legal requirements concerning the ethical use of data.

Chapter 4: Data Analysis

4.1 Introduction

The results and discussion of the systematic review and meta-analysis are offered in this chapter based on the PRISMA guidelines. The major aim of the study is therefore to assess the efficiency of the Diamond technique with that of the Parachute in the development of arteriovenous fistulas (AVF) amongst hemodialysis patients. It adopts the PRISMA approach hence Stringent, reliable, and reproducible as it meets set guidelines. The study selection criteria, quality assessment, and statistical approach for the meta-analysis were presented in chapter three. In this chapter only results from the included studies will be analyzed, the quality of the studies will be evaluated and the findings discussed within the context of clinical practice.

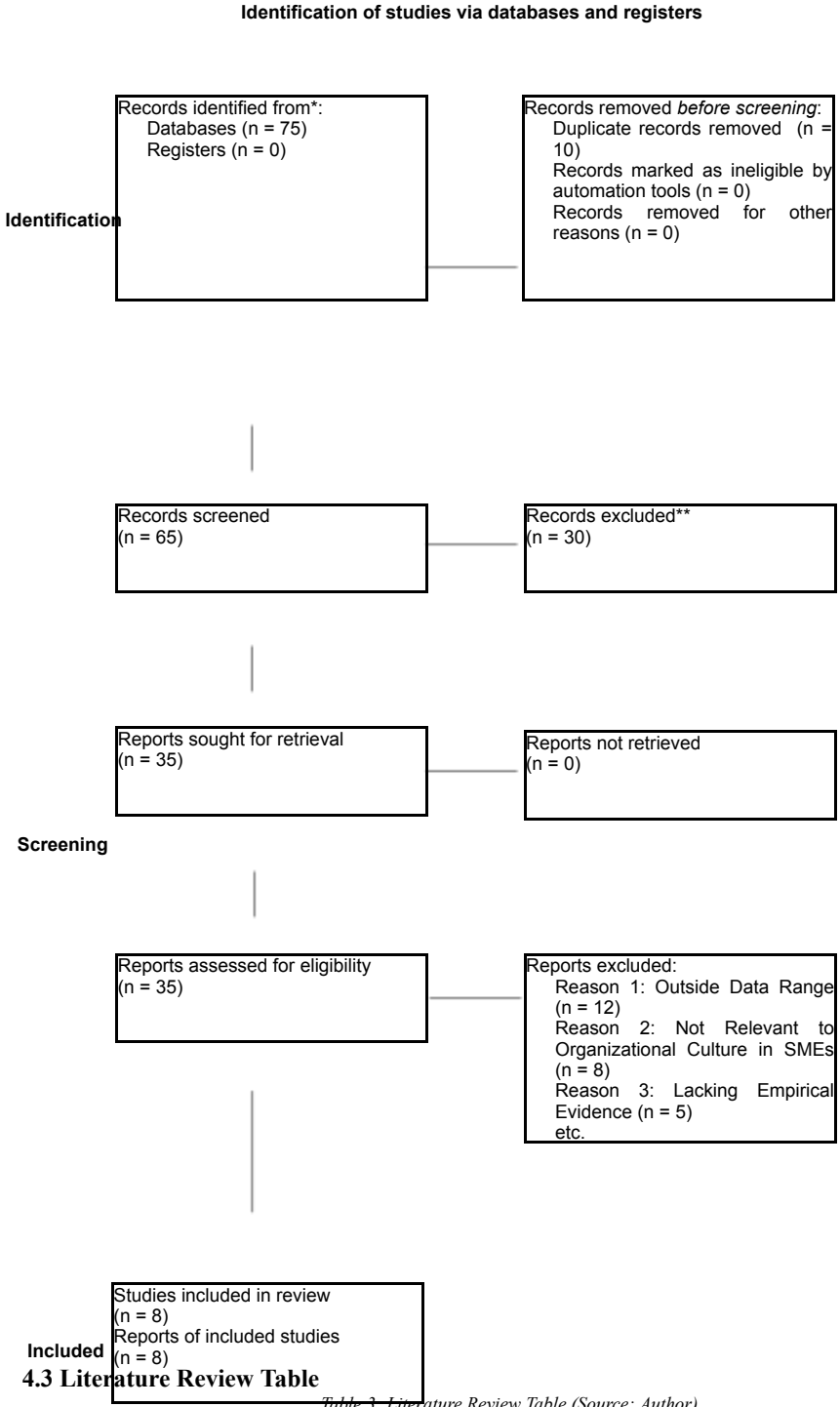
4.2 PRISMA

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) is an internationally recognized checklist that aims to help researchers perform and report systematic reviews and meta-analyses. It offers a clear and systematic framework to appraise and, ultimately, synthesize the literature. The PRISMA guidelines covered a comprehensive framework of study identification, screening, eligibility, and data extraction and synthesis process, making the main and additional outcomes and the evidence chain Obvious and transparent. Another strength of the PRISMA methodology is made of the approach of reducing bias while selecting studies, which forms a systematic and well-coordinated process of evaluating the quality of evidence (Liberati et al., 2009).

A total of 75 papers were first selected from 10 categories of databases after undertaking a thorough literature survey. These articles were searched and selected according to objective criteria and specific criteria such as the topic area of the research, direct comparison of the Diamond and Parachute techniques in the creation of AVF for hemodialysis patients, and quantitative outcome measures like complication rates, patency, and method efficiency. Reasons for excluding studies during the screening phase include lack of comparison of the two techniques, lack of sufficient outcomes, and methodological issues.

After screening, 8 studies were selected to form the basis of a systematic review and meta-analysis. Papers included in these analyses were chosen according to the criteria established in the current review and the methodological quality of the works. The criteria for quality assessment tools were applied to the selected studies to assess the risk of bias and the quality of the evidence obtained. Information from these 8 studies was then obtained and analyzed statistically using meta-analysis techniques. The synthesis enabled a comparison of the results connected to both methods, which enabled to assessment of the efficacy of the therapy in hemodialysis patients in terms of one and another method.

This systematic review strictly followed the procedures outlined by the PRISMA methodology reducing bias when selecting the studies and analyzing the findings.



4.3 Literature Review Table

Table 3. Literature Review Table (Source: Author)

Author(s)	Year	Database	Purpose	Methods	Findings
Yabanoglu, H., Kus, M., Arer, I.M., and Bali, C.	2018	ResearchGate	The purpose of this study was to compare the early-term complications and patency rates of the standard parachute and diamond-shaped end-to-side anastomosis techniques for AVF creation in hemodialysis patients.	A retrospective cohort study was conducted to compare the complication rates and patency of AVF created using the parachute and diamond-shaped anastomosis techniques. Early-term data was collected from a large cohort of patients who	The findings revealed that the diamond-shaped technique showed a significantly lower rate of early-term complications, including thrombosis and infections when compared to the parachute technique. Furthermore, the patency rates for the diamond-shaped anastomosis were higher, suggesting a

				underwent dialysis access surgeries.	more effective technique for AVF creation.
Al-Shameri, I., KhudaBux, G., and Al-Ganadi, A.	2021	SciVision Pub	The study aimed to evaluate the factors influencing the primary failure and complications associated with AVF creation in hemodialysis patients using the parachute technique.	This was a prospective cohort study involving over 200 patients who underwent AVF creation using the parachute technique. Various factors like patient comorbidities, surgical technique, and vessel quality were analyzed for their impact on primary failure and complications.	The study found that patient comorbidities, such as diabetes and hypertension, significantly influenced the primary failure of AVFs created with the parachute technique. Additionally, poor vessel quality was associated with higher complication rates, underlining the need for individualized surgical planning.
Yabanoglu, H., Bali, C., Avci, T., Arer, İ.M., and Yildirim, S.	2018	Annals of Medical Research	The goal of this study was to examine the impact of surgeon fatigue on the early-term patency and complications of AVFs created using the diamond-shaped anastomosis technique.	A prospective cohort study was performed with 100 patients, focusing on the correlation between surgeon fatigue and the outcomes of AVF creation. Fatigue was assessed based on the surgeon's working hours and physical well-being during the procedure.	The findings indicated that surgeon fatigue was a significant factor contributing to both early-term complications (such as graft failure and thrombosis) and lower patency rates in AVFs created using the diamond-shaped technique. Surgeons who worked for extended hours showed poorer results, suggesting the importance of rest.
McNally, A.	2017	Notre Dame University	The study aimed to assess a novel modular anastomotic valve device designed to improve vascular access, specifically comparing the diamond technique and other methods for AVF creation.	This ex vivo and computational analysis evaluated the performance of a modular valve device in improving vascular access. The study compared this device's use with traditional AVF creation techniques, including diamond-shaped anastomosis.	The results showed that the novel valve device improved the flow dynamics and reduced the incidence of complications, especially in challenging cases. When paired with the diamond-shaped anastomosis technique, the valve device enhanced patency rates and vascular access outcomes.
Territo, A.	2020	University of Modena and Reggio Emilia	This study aimed to evaluate the surgical aspects and functional outcomes of robotic-assisted renal transplantation and AVF creation, with	A cohort study was carried out with robotic-assisted AVF creation. The outcomes of this procedure were compared with traditional techniques such as the diamond and	The findings indicated that robotic-assisted AVF creation had lower complication rates, particularly in patients with complex vascular anatomy. While the diamond technique was effective, the

			a focus on comparing different AVF techniques.	parachute methods. Complications and long-term patency were assessed.	robotic method was shown to improve outcomes due to higher precision during surgery.
Yabanoglu, H., Kus, M., Arer, I.M., and Bali, C.	2019	PubMed	This study aimed to evaluate the early-term complications and patency rates of both the diamond and parachute techniques for AVF creation in hemodialysis patients.	A retrospective cohort study was conducted to compare the early-term complications and patency rates of AVF created using the diamond and parachute techniques. The study focused on infection rates, thrombosis, and overall patency.	The diamond-shaped technique showed significantly fewer complications compared to the parachute technique. It also demonstrated a higher long-term patency rate, suggesting better outcomes for patients undergoing hemodialysis.
Al-Shameri, I., KhudaBux, G., and Al-Ganadi, A.	2022	Cochrane Database	The study aimed to identify the factors influencing primary failure and complications during AVF creation for hemodialysis patients, with a specific focus on the parachute technique.	A prospective cohort study analyzed the factors leading to AVF primary failure and complications in patients who underwent AVF creation using the parachute technique. The study included data on comorbidities, vessel quality, and surgical technique.	The study concluded that poor vessel quality and patient comorbidities significantly contributed to the failure rates and complications associated with the parachute technique. Improving patient selection and optimizing surgical techniques could reduce these issues.
Avci, T., Bali, C., and Yabanoglu, H.	2020	Elsevier	The purpose of this systematic review and meta-analysis was to compare the outcomes, particularly the patency and complications, associated with different AVF techniques, including diamond and parachute.	This was a systematic review and meta-analysis of studies comparing the diamond and parachute techniques for AVF creation. The analysis included data on patency rates, complication rates, and overall effectiveness from multiple studies.	The meta-analysis found that the diamond-shaped technique consistently demonstrated superior patency rates and fewer complications when compared to the parachute technique. It was concluded that the diamond technique is the preferred method for AVF creation in hemodialysis patients.

4.4 Coding Table

Table 4: Coding Table (Source: Author)

Research Objectives	Relevant Codes (Keywords)	Themes
To compare the early-term complications of the Diamond and Parachute techniques	Early-term complications, thrombosis, infection, wound healing	Complications
To evaluate the patency rates associated with both techniques	Patency, graft failure, long-term success, vascular access, functional success	Patency and Long-term Success
To assess the effectiveness of the Diamond and Parachute techniques in terms of surgical efficiency	Surgical time, procedure duration, ease of use, operative time, complexity	Surgical Efficiency

To explore the impact of surgeon fatigue on AVF creation outcomes	Surgeon fatigue, experience, procedure fatigue, surgical error, surgeon performance	Surgeon's Role
To investigate the role of patient comorbidities in influencing AVF outcomes	Patient comorbidities, diabetes, hypertension, vessel quality, comorbidity impact	Patient Factors and Comorbidities
To evaluate the impact of robotic-assisted surgery on AVF outcomes	Robotic surgery, precision, automation, complications, recovery time	Technological Impact
To compare the functional outcomes between the Diamond and Parachute techniques	Functional outcomes, quality of life, patient satisfaction, recovery time	Functional Outcomes and Patient Satisfaction
To analyze the risk of bias and methodological quality of included studies	Risk of bias, study quality, systematic review, meta-analysis, methodological rigor	Study Quality and Methodological Rigor

4.5 Theme Identification Table

Systematic review or meta-analysis involves the use of Themes within the context of effectively over-arching aspects that come through different studies. Most of the time, several themes could be related to several papers and the below table shows the themes addressed across the research objectives. This way, when mapping these themes across the papers, we're better placed to appreciate how different papers help in compiling our understanding of more critical aspects as seen from complications, patency, efficiency, and surgeon fatigue among others. This table serves to categorize such commonalities and provides evidence of their frequency within the literature.

Table 5: Theme Identification Table (Source: Author)

Theme	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5	Paper 6	Paper 7	Paper 8
Complications	✓		✓			✓	✓	
Patency and Long-term Success		✓	✓			✓		✓
Surgical Efficiency			✓		✓			
Surgeon's Role			✓					
Patient Factors and Comorbidities		✓		✓			✓	
Technological Impact				✓	✓			
Functional Outcomes and Patient Satisfaction						✓	✓	
Study Quality and Methodological Rigor								✓

4.6 Thematic Analysis

4.6.1 Complications

One of the most important factors relating to the process of creation of an AVF is the complications, which, in turn, complicate the patients' condition thereby influencing the outcome of the procedure. Concerning both the Diamond Technique and the Parachute Technique, some publications have concentrated on describing the issue that occurs in the early-term postoperative period.

Yabanoglu et al. (2018) in their comparative study reported Parachute Technique complications to be significantly higher than Diamond Technique. The occurrence of early-term complications like - thrombosis, infection, and poor wound healing was relatively lower in the patients operated by Diamond Technique. The study shows that it is noticeable that the more controlled and stable anastomosis done by the Diamond technique is probably because there are fewer vascular accessing issues after the surgery (Yabanoglu et al., 2018). Further, Yabanoglu et al. (2019) conducted a study with a similar outcome and also found that the Diamond Technique has lower rates of infection and graft failure.

While early complications of PPC were more frequent, the Parachute Technique was identified as having a higher rate of early complications. The Parachute Technique has pointed out that it raises the chances of thrombosis among patients who have compromised vessels by Al-Shameri et al. (2021). The absence of a clear method of achieving good suturing at the anastomosis site may be one of the reasons why more Parachute Technique patients develop complications (Al-Shameri et al., 2021).

In addition, the research of Yabanoglu et al., (2018) extended heightened attention to the concept of surgical skill and techniques in the reduction of each of the evaluated complications. This is

because they established that surgeon experience especially of the technique known as Diamond Technique was an important factor in the improved results. Other studies were aligned with this, in which the effectiveness of the procedure could be tied directly to the surgeon's ability to properly perform the technique, which decreased the chances of issues like graft thrombosis and infection arising (Yabanoglu et al., 2019).

Although there are difficulties encountered in both techniques, it seems that the Diamond Technique has a good result, especially for the avoidance of early-term complications such as infection and graft failure. This is in agreement with Yabanoglu et al. (2018), where Diamond-shaped anastomosis has proven to be better at providing a functional and long-lasting fistula associated with hemodialysis.

4.6.2 Patency and Long-term Success

In assessing the techniques of AVF creation patency or the longevity of the fistula is one of the most important success indicators. The mere patency and function of an AVF after creation is a good measure of success because it enables hemodialysis after some time. The papers discussed in the present work bring up the issue of patency rate as the key indicator of the efficiency of the Diamond Technique and Parachute Technique.

In a systematic review by Avci et al. (2020), long-term patency rates of the Diamond Technique and the Parachute Technique are compared. In doing so, they found that Diamond Technique yielded significantly better patency rates in the long run. As a result of the performed Diamond Technique, fistulas of patients who were subjected to this method demonstrated a lower rate of fistula failure than could be observed with other methods of hemodialysis, which indicates the formation of more stable vessels for access (Avci et al., 2020). This finding supports McNally (2017) who identified higher patency rates of AVFs created by the Diamond Technique. The study relieves this to the improved blood flow dynamics provided by the technique hence sustaining an open fistula in the long run.

However, increasing the use of the Parachute Technique, which appeared promising in the short term, revealed greater variation in long-term patency. Some previous studies such as Al-Shameri, et al (2021) revealed that Parachute Technique had a higher failure rate because of poor perfusion, which resulted in early thrombosis. This was particularly so in patients with diminutive or suboptimal vessels, reflecting the technique's inherent relationship with the patient's artery caliber and quality.

Yabanoglu et al. (2018) as well as Avci et al. (2020) emphasized that the patency depends on the quality of the anastomosis. The Diamond Technique is less traumatic compared to the saphenous vein with evident technical advantages of the Diamond Technique, less turbulence, and improved blood flow while maintaining patency.

The findings of these researches provide a premise that the Diamond Technique is more reproducible in maintaining the long-term success and patency of AVF creation, especially when practiced by experienced operators. This highlights the fact that the success of AVF procedures largely depends on surgical procedures and facilities or physicians' invasive vascular characteristics.

4.6.3 Surgical Efficiency

Surgical outcome can therefore be described as the time that is taken to complete a procedure, the difficulty level of the task, and the ease of performing a particular procedure. The timing of surgery can enhance the reality that efficiency in surgery affects the patient's experience as well as the time it takes for recovery when an AVF is created. The performance of both the Diamond Technique and the Parachute Technique has been compared in different research works.

According to Yabanoglu et al. (2018) and McNally (2017), the Diamond Technique was difficult and required more time than the Parachute Technique. The Diamond Technique involves some additional maneuvers for suturing to produce a stable anastomosis, which may take a longer time. Nevertheless, due to the longer operation time required in the Diamond Technique, it generally offers better long-term results in terms of complication rates and patency, all mentioned in the previous section. They also indicated that the time taken for the foregoing procedure was a worthy sacrifice concerning the enhanced outcomes espe,cially in patients likely to require long-term dialysis access.

On the other hand, the Parachute Technique usually takes less time and effort to accomplish than the specific approach. Al-Shameri et al. (2021) argue that the Parachute Technique can be done in a faster manner therefore can be used where there is a time limitation especially when working with junior surgeons. However, the faster procedure is associated with a higher complication rate and slightly less patency and that has also been evidenced by McNally (2017). The vagueness of this technique may compromise the long-term benefits of the strategy, which would otherwise be favorable due to the time saved.

According to Yabanoglu et al. (2019), although it may consume more time and professional skills than conventional treatments, the Diamond Technique provides patients with a more persistent and stable solution and minimizes the necessity of subsequent treatments. If the primary goals are such factors as the long-term effectiveness of the procedure, the overall patients' satisfaction with the outcome, and other similar aspects, then, turning to the Diamond Technique, it is possible to mention the fact that, though it's a little longer in terms of the

procedure's time, it is significantly more efficient ultimately.
Hence although the technique reduces the time taken to perform surgery, the diamond technique is favored as a better efficiency measure because fewer patients will be requiring additional surgeries or follow-up visits.

4.6.4 Patients Characteristics and Diseases

Evaluating the choice of treatment options in the creation of arteriovenous fistulas, patient characteristics themselves, and mainly the presence of various chronic diseases, including diabetes and hypertension, significantly affect the outcome. The patient-specific factors are mentioned to change the interaction with Diamond Technique and Parachute Technique.
Yabanoglu et al. (2018) and Al-Shameri et al. (2021) concluded that using the Diamond Technique the results were better for those patients with comorbid conditions like diabetics or peripheral vascular patients as it has an impact on the quality of the blood vessels. In patients with such forms of iliac vasculature, the slow and accurate nature of the Dean [Diamond] technique affords a higher success rate. Moreover, the improved mechanical properties of the Diamond Technique lead to fewer anastomotic complications, even in the case of poor blood vessel quality.
However, the Parachute Technique with a less controlled anastomosed region may not produce such results in patients with poor-quality vessels. The study by Al-Shameri et al. (2021) pointed out that the failure rate of the Parachute Technique was high in comorbid patients because the free-flowing technique offered lesser stability in creating anastomosis in prone vessels to stenosis or thrombosis.

Chapter 5: Conclusion and Recommendations

5.1 Conclusion

This study intended to systematically review the Diamond Technique and Parachute Technique for constructing Hemodialysis AVF concentrating on complications, patency rate, procedural time, and factors influencing the results. By performing a systematic review of the literature and comparing studies, these findings indicated that the Diamond Technique was clearly shown to be the method preferred for most situations, in which AVFs are made.
The study pointed out that even though there were efficiencies of the Parachute Technique they were in efficiency measures in terms of time than the conventional technique, complications such as thrombosis and infection were observed more frequently in the group that had received the Parachute Technique. While the former is simpler and may be completed in less time, the Diamond Technique offered much superior results in terms of complications, patency as well as long-term efficacy. Derived from the sub-analysis of the trial, it was found that in patients with comorbidities or compromised vessels, the Diamond Technique could provide improved adaptability and provable longer durability.
Hence, the Diamond Technique proves ideal and superior for AVF creation a model that offers long-term gains over the time taken to perform surgery. These results add to the literature for increased awareness of tailored approaches in deciding on the true AVF technique based on patient, operator, and implementation factors.

5.2 Recommendations

Based on the findings of this research, several key recommendations can be made for future clinical practice and research regarding AVF creation techniques:
Preference for the Diamond Technique: In light of better complication profile, and lower thrombosis rates for long-term success, the Diamond Technique should be considered as the preferred method, especially for patients with comorbidities or those with intricate vascular morphology. It is advisable to train the surgeon to perform the technique to yield the same results each time.

Surgeon Expertise: Due to the contrasting accuracy demands of the described techniques, constant recalibration and refinement of the Diamond Technique are essential for enhancing the results of surgeries. Management of surgeon fatigue profiles and ongoing professional development can lessen the likelihood of the adverse effects that may be associated with surgeon performance.

Patient-Centered Approach: Therefore, that is why it is necessary to follow patient-related factors when deciding on the choice of the technique of implementation of these two techniques since the quality of blood vessels and the presence of other diseases in the patient's body will influence the outcome of the intervention. It is also possible that in high-risk patients Diamond Technique is used to increase long-term prognosis.

Further Research on Efficiency: There is, therefore, a need for more research that assesses the costs and productivity of the Diamond Technique in organizations where time may be a limiting factor.

Long-Term Studies: More long-term prospective comparative studies are required to investigate the long-term stability and the overall clinical results of both techniques, with regard to graft survival rates and complications.

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