

# Comparative study between one stage and two-stages superficialization of brachio-basilic arteriovenous fistula as a hemodialysis access procedure

Original  
Article

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## ABSTRACT

**Background:** The best technique for creating brachio-basilic arteriovenous fistulas (BBAVFs) is still up for debate. Because of this, the purpose of this study was to examine the patencies, primary failure rates, and complication rates of brachio-basilic arteriovenous fistulas formed using the one-stage and two-stage superficialization techniques.

**Patients and Methods:** In order to compare one stage and two-stage superficialization of brachio-basilic arteriovenous fistula, a prospective, randomized controlled clinical trial including 38 patients undergoing brachio-basilic arteriovenous fistula operations for end-stage renal disease was carried out. Two groups of patients were created using basic randomization. Patients in Group I underwent a single step of superficialization for their brachio-basilic arteriovenous fistula, whereas patients in Group II got a two-stage superficialization procedure.

**Results:** Patients with two-stage BBAVF had a substantially longer fistula maturation period than patients with one-stage BBAVF. However, patients with two-stage BBAVF also had considerably greater fistula flow rate and primary functional patency when compared to patients with one-stage BBAVF. In terms of the complications in both groups, patients with one-stage BBAVF had a considerably greater incidence of thrombosis and post-operative hematoma than patients with two-stage BBAVF. However, there was no discernible difference in the two groups' incidence of infection, steal syndrome, hematoma, or pseudoaneurysm.

**Conclusion:** An arteriovenous fistula (AVF) formation with BBAVF could be considered an attractive approach as it can help to reduce the risk of complications such as failure to mature, infection, distal ischemia, and venous edema. While two-stage BBAVF may have the drawback of delayed fistula use, it has been shown to be more effective than one-stage BBAVF in terms of minimizing postoperative complications.

**Key Words:** Arteriovenous fistula, brachio-basilic arteriovenous fistula, superficialization.

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## INTRODUCTION

Over the past 20 years, the Fistula First Breakthrough Initiative and the National Kidney Foundation Dialysis Outcomes Quality Initiative (NKF-DOQI) have collaborated to increase the development of autogenous arteriovenous fistulas (AVFs) for hemodialysis access while decreasing the need for prosthetic grafts<sup>[1]</sup>.

When selecting a vascular access for hemodialysis, native AVF should always be the first choice due to its patency, infection resistance. If the upper arm's cephalic vein cannot be utilized to generate an AVF, the basilic vein can be used to create a brachio-basilic AVF with superficialization<sup>[2]</sup>.

The 2006 changes to the NKF-DOQI Guidelines for hemodialysis access<sup>[3]</sup> state that a radiocephalic, brachiocephalic fistula (BCF), and a brachio-basilic fistula are the preferred forms of permanent access.

As the number of patients with brachio-basilic fistulae continues to rise and as end-stage renal disease patients survive longer, these fistulae are increasingly important for hemodialysis access<sup>[4]</sup>.

A growing number of patients, particularly younger ones who require veins secured for long-term hemodialysis, are using BB fistulae with superficialization despite their large surgical wound, prolonged hospital stay, and high primary failure rate. This is because they allow for the possibility of another vascular access prior to creating AVF

using prosthetic grafts. These characteristics are especially significant for young patients, as is the fact that after they develop, the rates of radiologic intervention are low once more<sup>[5]</sup>.

Before building a brachiobasilic AVF, duplex ultrasonography should be used to assess the basilic vein's diameter, architecture, and course. Determining if a mobilizable length is adequate is important. It has been noted that transpositioned brachiobasilic AVFs have greater patency frequencies than AVGs<sup>[1]</sup>.

BB fistulae have the potential to superficialize in one or two stages. There is now a lack of consistent and limited data about the patency rates of one-stage and two-stage surgeries as well as primary failure. Every approach has advantages and disadvantages. A meta-analysis of the literature comparing one-stage and two-stage procedures shows no differences in failure or patency rates, despite the two-stage operation being used on patients with smaller basilic veins<sup>[6]</sup>.

Significant advancements in fistula technology and salvage therapies have not decreased the overall high complication and failure rates, which remain between 20 and 60% of all fistulae failing within 3 months<sup>[2]</sup>.

### ***Aim of the work***

This study aimed to compare between one stage and two-stage superficialization of brachiobasilic arteriovenous fistula as regarding to the patencies, primary failure, and complication rates for fistulas created by the one-stage and two-stage technique.

### **PATIENTS AND METHODS:**

In order to compare one stage and two-stage superficialization of brachiobasilic arteriovenous fistula, thirty-eight patients who underwent brachiobasilic arteriovenous fistula procedures for end-stage renal disease participated in this prospective, randomized controlled clinical study at Helwan University's Faculty of Medicine. There were two groups of patients. Group I consisted of 19 patients who received a single step of superficialization for their brachiobasilic arteriovenous fistula, whereas Group II included 19 patients who underwent a two-stage superficialization procedure. Patients who were over the age of eighteen, both sex, and had a failed or inappropriate cephalic vein at the wrist or antecubital fossa met the inclusion criteria. Patients with poor ejection fraction, congestive heart failure met the exclusion criteria with individuals with healthy cephalic veins, Individuals who have suffered arm burns or infections in the past and Patients with short basilic vein in the arm.

Every patient had their medical history taken, a general checkup, and a local examination for any burns, infections, or surgical procedures. Coagulation profile, complete blood count, liver and kidney functions, random blood sugar, and electrolytes are among the laboratory investigations that are performed. Using duplex mapping, the upper limb venous system may be examined to measure the basilic vein's diameter over its entire course, rule out basilic vein division, and rule out thrombosis or stenosis of the central veins.

### ***Surgical technique***

#### ***Technique of one stage BB fistulae***

General or regional anesthesia was used for the one-stage procedure. Using an ultrasound to identify the basilic vein and a transverse 5-cm incision in the antecubital fossa at crease level, along with prior brachial artery pulse detection, the medial side of the arm was marked with a skin incision following the basilic vein's path. The deep fascia below was exposed by extending the incision proximally. Up to the point where it joined the brachial veins, the basilic vein was mobilized. The forearm's median cutaneous nerve was meticulously dissected and maintained. The basilic vein was detached and subcutaneously tunneled through a counter incision after the side branches were ligated. The brachial artery was connected to basilic vein by arteriovenous anastomosis end-to-side (Figs. 1–3).

#### ***Technique of two stage BB fistulae***

Under local anesthetic, the first part of the two-stage surgery involved minimally disturbing the basilic vein and forming an arteriovenous anastomosis between the brachial artery and basilic vein at the antecubital fossa, at the level of the crease at the brachial pulse point. A flow evaluation of the AVF using duplex scanning was performed after four to six weeks to see if a second stage anastomosis adjustment was required. Regional anesthetic was used during the second part of the procedure. By using ultrasonography, the complete basilic vein's length was marked. A skin incision was then made, and the skin, subcutaneous tissue, and deep fascia were dissected and opened. A 'subcutaneous flap' was then formed after the basilic vein was mobilized and side branches were ligated, and the vein was positioned anterolaterally then closure of harvesting site with drain and skin closure. Usually, a further 2 weeks was required before the AVF can be used.

### ***Follow up***

All patients were followed up for 1 year after surgery with intervals of 1 week in 1<sup>st</sup> 2 months then every 1 month

- (1) The patency rate of AVF was documented.

(2) Accessibility of superficialized vein in hemodialysis sessions.

(3) Maturation time between the two procedures and the access was considered mature and successful if cannulation was possible for dialysis with a flow rate of at least 300 ml/min.

(4) The patient who underwent any kind of intervention was recorded.

(5) Complications were recorded as thrombosis, hematoma, wound infection, steal, stenosis and venous hypertension.

**Ethics approval**

Patients were enrolled after obtaining informed consent. The privacy of the patients and their medical and personal data were kept confidential. Approval was obtained from Helwan University Institutional Review Board (IRB #). Consent from all patient on participating in the study. The Declaration of Helsinki, the international Medical Association’s guideline of ethics for studies involving humans, was followed in the conduct of this study.

**Statistical analysis**

All data throughout history, clinical examination, laboratory and imaging investigations and outcome

measures were collected, tabulated and analyzed using (Statistical Package for the Social Sciences) SPSS version 28 of IBM, USA. Shapiro-Wilks normality test and histograms were used to test the distribution of quantitative variables to select accordingly the type of statistical testing parametric or nonparametric. Parametric variables (e.g., age) were expressed as mean and standard deviation (SD) and were compared using t test between the two groups. Non- parametric variables were expressed as median and interquartile range (IQR) and were analyzed using the Mann-Whitney test.

**RESULTS:**

Patients with two-stage BBAVF had a substantially longer fistula maturation period. However, patients with two-stage BBAVF also had greater fistula flow rate and primary functional patency when compared to patients with one-stage BBAVF. In terms of the complications, patients with one-stage BBAVF had a considerably greater incidence of thrombosis and post-operative hematoma. However, there was no discernible difference in the two groups’ incidence of infection, steal syndrome, hematoma, or pseudoaneurysm.

**Table 1:** Demographic characteristics & coagulation profile of the studied groups

	One-stage BBAVF (n=19)	Two-stage BBAVF (n=19)	P value
Age (years)			
Mean±SD	56.79±12.26	59±10.41	0.553
Range	35–78	38–82	
Sex			
Male	11 (58%)	13 (68%)	0.737
Female	8 (42%)	6 (32%)	
BMI (kg/m <sup>2</sup> )			
Mean±SD	27.82±4.85	25.45±2.64	0.07
Range	17.7–34.8	19.1–29.3	
PT (sec)			
Mean±SD	15.32±2.31	14.95±2.93	0.669
Range	11–20	10–22	
APTT (sec)			
Mean±SD	37.53±5.82	41.05±5.94	0.073
Range	30–49	33–51	
INR			
Mean±SD	1.59±0.43	1.78±0.39	0.172
Range	1–2.7	1.4–2.8	
Platelet count (10 <sup>3</sup> /ml)			
Mean±SD	367.05±57.2	374.95±55.58	0.669

Range	276–454	245–445	
Bleeding time (min)			
Mean±SD	6.68±2	5.84±1.07	0.139
Range	3–11	4–7	
D-dimer (ng/dl)			
Mean±SD	264.4±38.7	298±73.96	0.086
Range	180–337	146–406	

\*Significant as  $P$  value  $\leq 0.05$ .

\*\*Highly significant as  $P$  value  $\leq 0.001$ .

BBAVF, Brachiobasilicarteriovenous fistula; BMI, Body mass index; SD, Standard deviation.

Table 1; showed there was no significant difference in demographic characteristics (age, sex, and BMI) between patients who underwent one-stage or two-stage BBAVF & there was no significant difference in coagulation

profile (PT, APTT, INR, platelet count, bleeding time, and D-dimer) between patients who underwent one-stage or two-stage BBAVF.

**Table 2:** Disease history in the studied groups

	One-stage BBAVF ( $n=19$ )	Two-stage BBAVF ( $n=19$ )	$P$ value
ESRF duration (months)			
Mean±SD	64.32±19.34	58.68±22.2	0.409
Range	22–100	20–101	
Previously opened AVF			
Mean±SD	5.32±1.16	4.68±1.49	0.114
Range	3–7	2–8	
Medical history			
HTN	11 (58%)	9 (47%)	0.736
DM	7 (37%)	4 (21%)	0.476
Heart disease	1 (5%)	2 (11%)	1.000
PVD	2 (11%)	3 (16%)	1.000
Smoking	8 (42%)	6 (32%)	0.737

\*Significant as  $P$  value  $\pm 0.05$ .

\*\*Highly significant as  $P$  value  $\pm 0.001$ .

BBAVF, Brachiobasilicarteriovenous fistula; BMI, Body mass index; DM, Diabetes mellites; ESRF, End stage renal failure; HTN, Hypertension; PVD, Peripheral vascular disease; SD, Standard deviation.

Table 2; showed there was no significant difference in ESRF duration or number of pervious AVF between patients who underwent one-stage or two-stage BBAVF. Also, there was no significant difference in medical history

(patients with HTN, DM, heart diseases, and peripheral vascular disease) or number of smokers between patients who underwent one-stage or two-stage BBAVF.

**Table 3:** Artery and venous diameters in the studied groups

	One-stage BBAVF ( $n=19$ )	Two-stage BBAVF ( $n=19$ )	$P$ value
Basilic vein diameter (mm)			
Mean±SD	3.16±0.37	2.42±0.61	<0.001**
Range	3–4	2–4	
Brachial artery diameter (mm)			
Mean±SD	3.89±1.1	3.58±1.3	0.318
Range	2–6	2–7	

\*Significant as  $P$  value  $\leq 0.05$ .

\*\*Highly significant as  $P$  value  $\leq 0.001$ .

BBAVF, Brachiobasilicarteriovenous fistula; SD, Standard deviation.

COMPARISON BETWEEN BRACHIOBASILIC SUPERFICIALIZATION

Basilic vein diameter was significantly higher in patients who underwent one-stage BBAVF compared to patients who underwent two-stage BBAVF. But brachial artery diameter was comparable between patients who underwent one-stage or two-stage BBAVF as shown as Table 3.

BBAVF: Brachiobasilicarteriovenous fistula, SD: Standard deviation, PT: prothrombin time, APTT: Active partial thromboplastin time, INR: international normalized ratio, \*Significant as  $P$  value  $\pm 0.05$ , \*\*Highly significant as  $P$  value  $\pm 0.001$ .

**Table 4:** BBAVF characteristics of the studied groups

	One-stage BBAVF (n=19)	Two-stage BBAVF (n=19)	P value
Fistula maturation			
Yes	11 (58%)	16 (84%)	0.151
No	8 (42%)	3 (16%)	
Fistula maturation time (day)			
Mean±SD	40.73±12.07	66.19±29.81	0.013*
Range	23–63	19–109	
Fistula flow rate (ml/min)			
Mean±SD	286.58±20.1	302.63±27.25	0.046*
Range	255–325	220–335	
Primary functional patency (days)			
Mean±SD	210.79±45.3	259.47±43.87	0.002*
Range	110–275	190–370	

\*Significant as  $P$  value  $\pm 0.05$ .

\*\*Highly significant as  $P$  value  $\pm 0.001$ .

BBAVF, Brachiobasilicarteriovenous fistula; SD, Standard deviation.

The fistula maturation was similar in individuals undergoing BBAVF in stages one and two. Patients with two-stage BBAVF had a substantially longer fistula maturation period than patients with one-stage BBAVF.

However, as (Table 4) illustrates, patients with two-stage BBAVF also had considerably greater fistula flow rate and primary functional patency when compared to patients with one-stage BBAVF.

**Table 5:** Complications of the studied groups

	One-stage BBAVF (n=19)	Two-stage BBAVF (n=19)	P value
Infection	3 (16%)	4 (21%)	1.000
Thrombosis	9 (47%)	2 (11%)	0.029*
Post operative Bleeding	11 (58%)	4 (21%)	0.045*
Steal syndrome	2 (11%)	3 (16%)	1.000
Hematoma	5 (26%)	2 (11%)	0.405
Pseudo-aneurysm	1 (5%)	2 (11%)	1.000

\*Significant as  $P$  value  $\leq 0.05$ .

\*\*Highly significant as  $P$  value  $\leq 0.001$ .

BBAVF, Brachiobasilicarteriovenous fistula; SD, Standard deviation.

Table 5 the complications in both group, incidence of thrombosis and post operative bleeding were significantly higher in patients who had one-stage BBAVF compared to patients who had two-stage BBAVF. But there was no

significant difference in the incidence of infection, steal syndrome, hematoma, and pseudoaneurysm between both groups.



## DISCUSSION

The demographic features (age, sex, and BMI) of patients undergoing one-stage or two-stage BBAVF did not significantly differ in the current research.

Ozcan *et al.*<sup>[7]</sup> compared the outcomes of one- and two-stage basilic vein transposition in hemodialysis patients by conducting a non-randomised, retrospective analysis on 96 patients with ESRF who had BBAVF between January 2007 and January 2012. He stated that there was a significant age and sex gap between the two groups.

Patients who had one-stage or two-stage BBAVF did not significantly vary in terms of ESRF duration or number of previous AVFs in the current research.

Also, there was no discernible difference between patients with one-stage or two-stage BBAVF in terms of the ESRF duration or the number of previous AVFs, according to Ozcan *et al.*<sup>[7]</sup>.

The medical histories of patients who had one-stage or two-stage BBAVF in the current study did not significantly differ (patients with HTN, DM, cardiac illnesses, and peripheral vascular disease).

This is a follow-up to a research by Lebda *et al.*<sup>[8]</sup> that involved 56 patients with ESRF in order to examine the creation of BBAVF using one-stage and two-stage procedures. They discovered that patients who had one-stage or two-stage BBAVF did not significantly differ in the frequency of patients with DM, HTN, or cardiac problems.

Furthermore, a research conducted by Tan *et al.*<sup>[9]</sup> compared BBAVFs produced utilizing the one-stage and two-stage techniques, identifying 2648 patients who had received the procedure within the Vascular Quality Initiative data set from 2010 to 2016. They found that patients who received one-stage or two-stage BBAVF did not significantly vary in terms of their medical histories (HTN, DM, coronary artery disease, and congestive heart failure).

In the current study, patients who had one-stage BBAVF had a considerably larger basilic vein diameter than patients who had two-stage BBAVF. However, there was no difference in brachial artery diameter between individuals undergoing one-stage and two-stage BBAVF.

This is consistent with the findings of Ozcan *et al.*<sup>[7]</sup>, who found that while there was no significant difference in the mean brachial artery diameter, patients who received one-stage surgery also had mean

basilic vein diameters that were considerably bigger than those who underwent two-stage surgery.

Furthermore, patients who had one-stage surgery had considerably larger target vein diameters than those who had two-stage surgery, according to Tan *et al.*'s<sup>[9]</sup> study, although there was no significant difference in mean brachial artery diameter.

Additionally, patients who had one-stage BBAVF had a considerably larger basilic vein diameter than patients who had two-stage BBAVF, according to the Vrakas *et al.*<sup>[10]</sup> research.

Furthermore, Moslem *et al.*<sup>[11]</sup> divided 50 patients with ESRF into two groups for their investigation. To demonstrate the distinction between the one and two phases of BBAVF, the first group consisted of 25 individuals with one stage BBAVF and the second group, consisting of 25 individuals with two stages BBAVF. They demonstrated that patients who had one stage BBAVF had much larger target veins. However, the target arterial diameter did not significantly differ between the two methods.

The coagulation profiles (PT, APTT, INR, platelet count, bleeding time, and D-dimer) of patients who had one-stage or two-stage BBAVF did not significantly differ, according to the current study.

Furthermore, the coagulation profile (PT, APTT, INR, platelet count, bleeding duration, and D-dimer) did not significantly change between the two groups, according to Ozcan *et al.*<sup>[7]</sup>.

Fistula maturation was similar in individuals undergoing one-stage and two-stage BBAVF in the current research.

Comparably, patients who received one-stage or two-stage BBAVF did not significantly vary in primary failure in the Vrakas *et al.* (2010) research.

This contradicts the findings of Ozcan *et al.*<sup>[7]</sup>, who found that patients with two-stage BBAVF superficialization had a considerably greater fistula maturation rate than patients with one-stage superficialization.

In the current investigation, patients with two-stage BBAVF had a considerably longer fistula maturation period than patients with one-stage BBAVF. Additionally, individuals with two-stage BBAVF had a considerably greater fistula flow rate than patients with one-stage BBAVF.

These results were in line with those of Ozcan *et al.*<sup>[7]</sup>, who found that patients with two-stage BBAVF had considerably longer fistula maturation times and fistula flow rates than patients with one-stage BBAVF.

Additionally, Kakkos *et al.*<sup>[12]</sup> compared the results of a modified, two-stage procedure with a one-stage basilic vein transposition fistula by doing a retrospective case-controlled analysis on 173 patients. According to their research, individuals who had a two-stage procedure had a considerably longer fistula development period.

In the current study, primary functional patency was significantly higher in patients with two-stage BBAVF compared to with patients with one-stage BBAVF.

In consistent with our results, Vrakas *et al.*<sup>[12]</sup> study which showed that primary functional patency was significantly higher in patients with two-stage BBAVF compared to with patients with one-stage BBAVF.

Also, in Moslem *et al.*<sup>[11]</sup> study primary functional patency was significantly higher in patients with two-stage BBAVF compared to with patients with one-stage BBAVF.

In order to compare the clinical efficacy and cost-effectiveness of one-stage vs. two-stage BBAVF, Ghaffarian *et al.*<sup>[13]</sup> identified all patients at a single large academic hospital who had undergone creation of either a one-stage or two-stage superficialization of BBAVF between January 2007 and January 2015. At two years, they showed that the two-stage method has better functional patency. Over the course of five years, the two-stage technique proved to be more cost-effective, despite being initially more expensive due to the requirement for a second treatment.

In terms of the study's consequences, patients with one-stage BBAVF had a considerably greater incidence of thrombosis and hemorrhage than patients with two-stage BBAVF. However, there was no discernible difference in the two groups' incidence of infection, steal syndrome, hematoma, or pseudoaneurysm.

Comparing patients who received one-stage BBAVF to those who underwent two-stage BBAVF, Ozcan *et al.*<sup>[7]</sup> showed a substantially increased frequency of early thrombosis, hemorrhage, and hematoma, which is consistent with the current research.

Furthermore, compared to two-stage techniques, one-stage fistula operation complications were considerably greater in the Kakkos *et al.*<sup>[12]</sup> study.

Furthermore, compared to patients who received two-stage BBAVF, the incidence of complications (post-operative hemorrhage, wound infection, and edema) was considerably greater in the Tan *et al.*<sup>[9]</sup> research.

But in contrast with our study, Vrakas *et al.*<sup>[10]</sup> study showed that there was no significant difference in complications between patients who underwent one-stage BBAVF compared to patients who had two-stage BBAVF. However, there was a trend toward more thrombosis in the one-stage operation. The difference between their outcome and the current one may be explained by the fact that it was a nonrandomized study, therefore allowing for selection bias. Personal preference of the two operating surgeons affected the type of operation.

The current study had some limitations; Single center study may result in different findings than elsewhere. Small sample size that may produce insignificant results. Follow-up duration was relatively short, and a longer period is needed for gathering more accurate results regarding patency and complication rates.

## CONCLUSION

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AVF formation with BBAVF could be considered an attractive approach as it can help to reduce the risk of complications such as failure, infection, distal ischemia, and venous edema. While two-stage BBAVF may have the drawback of delayed fistula use, it has been shown to be more effective than one-stage BBAVF in terms of minimizing postoperative complications.

## RECOMMENDATIONS

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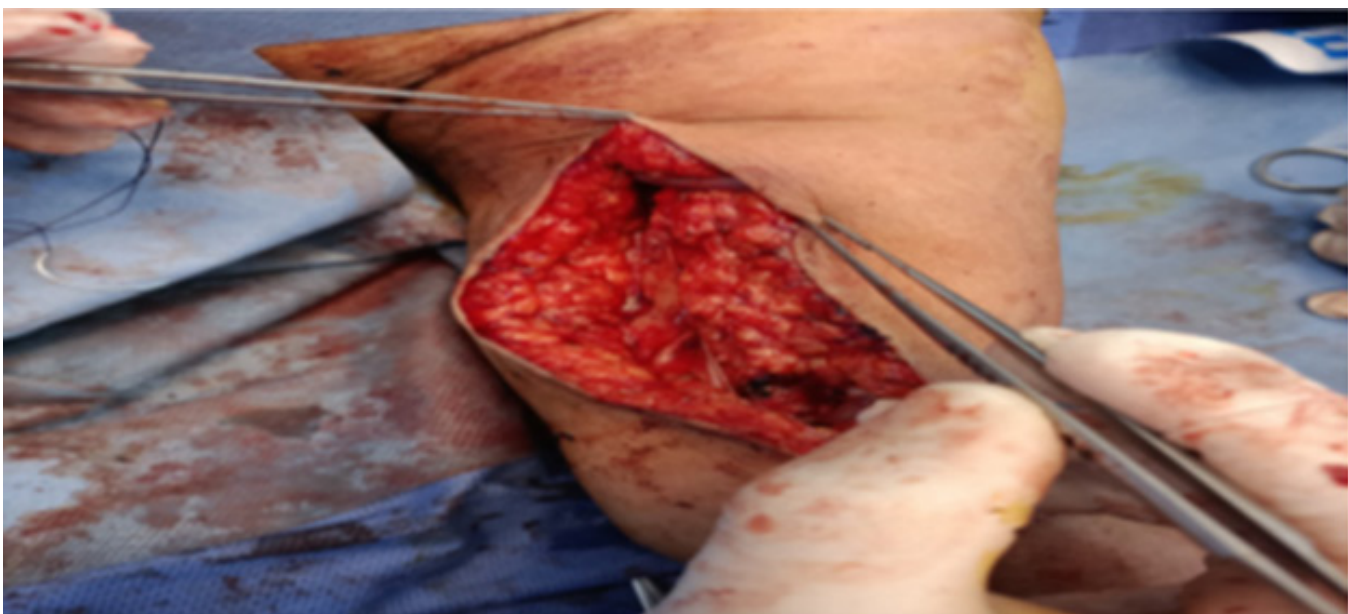
We recommend Further studies in other centers to compare findings. Further studies with larger sample size produce more accurate results. Until further studies can determine the superior technique, it is advisable to individually design the approach to be used.



**Fig. 1:** Shows basilic vein after dissection with meticulous preservation of nerves & ready for mobilization.



**Fig. 2:** Shows basilic vein after tunneling in anterolateral position and arteriovenous anastomosis.



**Fig. 3:** Basilic vein tunneled in sub cutaneous tissue in anterolateral position.



### CONFLICT OF INTEREST

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No conflict of interest disclosure.

### REFERENCES

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1. Hussien Salama M. comparative study between one-stage and two- stage brachio basilic arteriovenous fistula as a hemodialysis access procedure. *Al-Azhar Med J* 2016; 45:483-491.
2. Canaud B, Ponce P, Parisotto MT, Busink E, Apel C, Rammo J, *et al.* 2019. Vascular Access Management for Haemodialysis: A Value-Based Approach from NephroCare Experience. In: ALEXANDER, E. B. (ed.) *Vascular Access Surgery*. Rijeka: IntechOpen. Ch. 2
3. Hemodialysis Adequacy 2006 Work Group. Clinical practice guidelines for hemodialysis adequacy, update 2006. *Am J Kidney Dis* 2006; 48(Suppl 1):S2-S90.
4. Agarwal A, Mantell M, Cohen R, Yan Y, Trerotola S, Clark TW. Outcomes of single-stage compared to two-stage basilic vein transposition fistulae. *Semin Dial* 2014; 27:298-302.
5. Srivastava A, Sharma S. Hemodialysis vascular access options after failed Brescia-Cimino arteriovenous fistula. *Indian J Urol* 2011; 27:163-168.
6. Cooper J, Power AH, DeRose G, Forbes TL, Dubois L. Similar failure and patency rates when comparing one- and two-stage basilic vein transposition. *J Vasc Surg* 2015; 61:809-816.
7. Ozcan S, Gür AK, Yener AU, Odabaşı D. Comparison of one- and two-stage basilic vein transposition for arterio-venous fistula formation in haemodialysis patients: preliminary results. *Cardiovasc J Afr* 2013; 24:364-368.
8. Lebda MU, Alsamea YMA, Salem AM. One-stage versus two-stage brachio-basilic arteriovenous fistula with superficialization of the basilic vein regarding patency and failure rates. *Egypt J Surg* 2022; 41:42-49.
9. Tan TW, Siracuse JJ, Brooke BS, Baril DT, Woo K, Rybin D, *et al.* Comparison of one-stage and two-stage upper arm brachio-basilic arteriovenous fistula in the Vascular Quality Initiative. *J Vasc Surg* 2019; 69:1187-1195.e2.
10. Vrakas G, Defigueiredo F, Turner S, Jones C, Taylor J, Calder F. A comparison of the outcomes of one-stage and two-stage brachio-basilic arteriovenous fistulas. *J Vasc Surg* 2013; 58:1300-1304.
11. Moslem HR, Salem AA, Zidan AM, Salama MA. One-stage versus two-stage Brachio-Basilic Arteriovenous Fistula for dialysis access. *Benha J Appl Sci* 2021; 6:295-301.
12. Kakkos SK, Haddad GK, Weaver MR, Haddad RK, Scully MM. Basilic vein transposition: what is the optimal technique? *Eur J Vasc Endovasc Surg* 2010; 39:612-619.
13. Ghaffarian AA, Griffin CL, Kraiss LW, Sarfati MR, Brooke BS. Comparative effectiveness of one-stage versus two-stage basilic vein transposition arteriovenous fistulas. *J Vasc Surg* 2018; 67:529-535.e1.