# A COMPARATIVE STUDY OF THE DISTAL RADIO-CEPHALIC VERSUS PROXIMAL RADIO-CEPHALIC SURGICALLY CREATED ARTERIO-VENOUS FISTULAS AS THE PERIPHERAL ACCESS FOR MAINTENANCE HEMODIALYSIS FOR END-STAGE RENAL DISEASE

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## ABSTRACT
### BACKGROUND
There are many modalities of vascular access in patients undergoing haemodialysis. The Distal radiocephalic fistula (DRCF) is the most commonly performed peripheral access for ESRD for Maintenance Hemodynamics [MHD]. Due to its high blockage and failure rate, DRCF is swiftly replaced by a Brachiocephalic AVF or a Proximal Radio-Cephalic AVF.

### AIM OF THE STUDY
This study aims to compare and contrast the efficacy, outcomes, long-term patency, and failure rate of the PRCF and DRCF in ESRD patients.

### MATERIALS AND METHODS
A prospective observational comparative study was conducted at the department of CTVS from December 2023 to March 2025. Data was collected in a semi-structured proforma and entered in Microsoft Excel. If applicable, categorical data was tested using a Chi-square for count and proportion or by Fischer`s exact test. Quantitative data by Mean and SD were tested by unpaired t-test and comparison of the two procedures by the Kaplan-Meier method and evaluated by the long-rank test. A p-value <0.05 was considered statistically significant.

### RESULTS
Both groups were comparable in their demographic parameters.  The DRCF group had narrow calibres compared to the PRCF group. Each PRCF group has had a DRCF failure due to narrow and incompatible calibres or thrombus formation. Early failure was lower for PRCF and hence functional longevity. Early failure rates were 7% in PRCF and 17.5%  in DRCF. The patency rate was 83% in PRCF and 70% in DRCF.

**CONCLUSION:** PRCF should be considered in failed DRCF cases before going in for BCF.

**Keywords:** Chronic kidney disease, peritoneal dialysis, vascular access,

## INTRODUCTION
In patients with CKD/ESRD, many alternatives exist for peripheral access for haemodialysis, as central access is often transitory and utilized only in emergencies as a life-saving measure.

Furthermore, both jugular and femoral access are challenging to sustain long-term due to positional disadvantages, elevated infection rates, and sepsis; therefore, permanent peripheral access is essential for maintenance haemodialysis (MHD). [1,2]

Peritoneal dialysis may serve as a temporary access method when utilizing disposable sets; however, it can be converted into a long-term access solution by surgically inserting a long silicone catheter (Tenckhoff) into the peritoneal cavity and tunnelling it to the exterior, which remains a temporary measure. Consequently, peripheral access is essential for long-term maintenance haemodialysis (MHD). [3,4]

Among various options such as AV grafts, AV catheters, and AVF creation, the AVF is regarded as superior in terms of longevity of patency and a lower incidence of complications. AV grafts and AV catheters are associated with elevated complications such as infections, thrombosis, and occlusion or stenosis of the channel. [3] The necessity for interventions to preserve patency after the maturation of an arteriovenous fistula is significantly lower than that for arteriovenous grafts or catheters. Due to multiple factors, the primary failure rate of arteriovenous fistulas (AVF) can reach 40-60%. Failure rates are higher in females, diabetics, and elderly patients. [3,5]

Failure rates and insufficient maturation are more prevalent when the radial artery width is below 2 mm and flow rates are under 40 ml/second, accompanied by atherosclerotic intra-arterial calcifications and concretions, as well as chronic kidney disease of extended duration. [6] The diameter of the cephalic vein is equally significant; if it < 2.5 mm, the failure rates increase. [6] The standard sequence involves the creation of a Radio-Cephalic Fistula, followed by a Brachio-Cephalic Fistula, and ultimately a Brachio-Basilic Fistula. In the event of DRCF failure, the standard procedure is to execute a Brachio-Cephalic A-V-F. [7]

Our study emphasizes that, in the event of DRCF failure, a repeat arterio-venous Duplex should be conducted to ascertain the underlying cause of failure and further clarify the trajectory and diameter of the Radial artery and Cephalic vein proximally in the forearm. This will enable a definitive decision regarding the performance of PRCF.

## MATERIALS AND METHODS
This was a prospective comparative observational study that included 30 patients with ESRD on MHD. All the patients had an upper limb A-V Duplex to determine the caliber, flow, and distance of the Radial artery from the surface. The vein's compressibility was checked cautiously to rule out any intra-luminal vein thrombosis.

## INCLUSION CRITERIA FOR DRCF
Radial artery of >2mm, flow rate of > 40 ml/ second
Cephalic vein of > 2.5mm without any intra-luminal thrombosis at wrist
Previous failed DRCF at wrist

## EXCLUSION CRITERIA FOR PRCF
Radial artery of <2mm, flow rate of<40ml/second at wrist
Cephalic vein of < 2.5mm, thrombosed at wrist

## SURGICAL PROCEDURE:
All procedures were conducted under local anaesthesia using ordinary 2% lignocaine. A longitudinal incision of 4-5 cm was performed immediately proximal to the unsuccessful DRCF in situations when Duplex imaging indicated apparent patency of the cephalic vein and a matching calibre of the

corresponding radial artery. If the cephalic vein was patent, an end-to-side anastomosis was executed by adhering to the subsequent stages for the most proximal anastomosis.

A longitudinal incision is often performed 4-5 cm below the cubital fossa or in the forearm for proximal Radio-Cephalic anastomosis, situated in between the Brachio-Radialis and Flexor-Carpi-Radialis muscles.

The standard procedures for both forms of proximal anastomosis are outlined here. The cephalic vein was recognized and skeletonized, branches were ligated, transected, and severed distally following double ligation at the distal end, the vein was spatulated, and valvotomy was executed by gently using a long probe or utilizing a size 7 feeding tube. Heparinized saline was administered via a 20G venous cannula in place, and proximal flow was verified as unobstructed. The median antebrachial vein, when present, was favoured for anastomosis. Systemic heparin administration was performed. The radial artery was palpated, located, elevated, looped, and liberated from the surrounding delicate fibrous tissue. Following the application of Bulldog clamps both proximally and distally, a sufficient arteriotomy is executed using an 11-blade surgical scalpel within the inter-Bulldog interval, ensuring that the posterior wall of the artery remains unscathed. Proper flow was verified by removing the proximal Bulldog clamp and subsequently reapplying it. Assessment of the adequacy of arteriotomy performed using forward and backward Potts scissors. The arteriotomy lumen was gently flushed with heparinized saline. An end-to-side vascular anastomosis was executed using a 7-O (0.5 metric, 60 cm, 8mm 3/8 circle, taper-point double-armed Prolene suture) via the parachute method, commencing with the heel followed by the toe. Initially, the distal Bulldog clamps were withdrawn, followed by the proximal clamps, and Papaverine saline was gently irrigated in the area around the anastomosis. Vein distension noted and proximal palpable thrill detected, suggesting effective arteriovenous fistula development. Following the confirmation of complete hemostasis at the anastomotic and incision sites, the skin was approximated using 1 Prolene suture. The hand-held Doppler verified the effective development of an arteriovenous fistula.

**FIGURE-1**
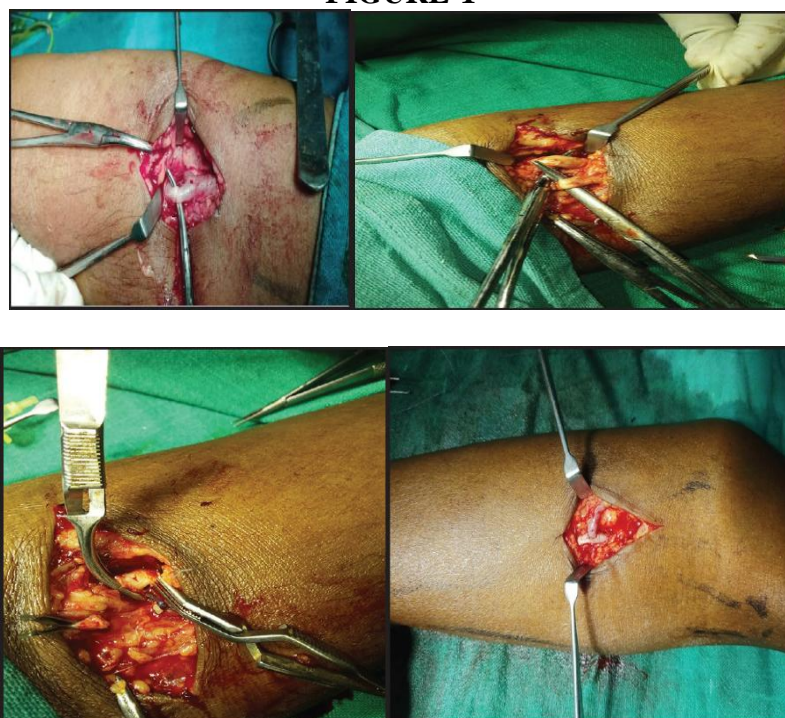
Sonographic maturation of the A-V-F was confirmed by vein diameter of > .6mm, flow > 600 ml and distance from the skin of <0.6 cm gradually. Cannulation of the A-V-F was advised after 6-8 weeks after sonographic maturation.

## STATISTICAL ANALYSIS

The data was collected in a semi-structured proforma and entered in Microsoft Excel. It was then analyzed using SPSS v26.1.

Quantitative data were calculated in the form of Mean and SD and were tested by unpaired t-test. Categorical data was presented as count and proportion and was tested by the Chi-square test or, if applicable, Fischer's exact test. The two procedures were compared using the Kaplan-Meier method and evaluated by the log-rank test. A p-value of $< 0.05$ was considered statistically significant during the analysis.

## RESULTS:

The mean age of the patients was $57.47 \pm 14.14$ years, with a minimum age of 30 and a maximum age of 75. The male-to-female ratio was 2:1 in the study population.
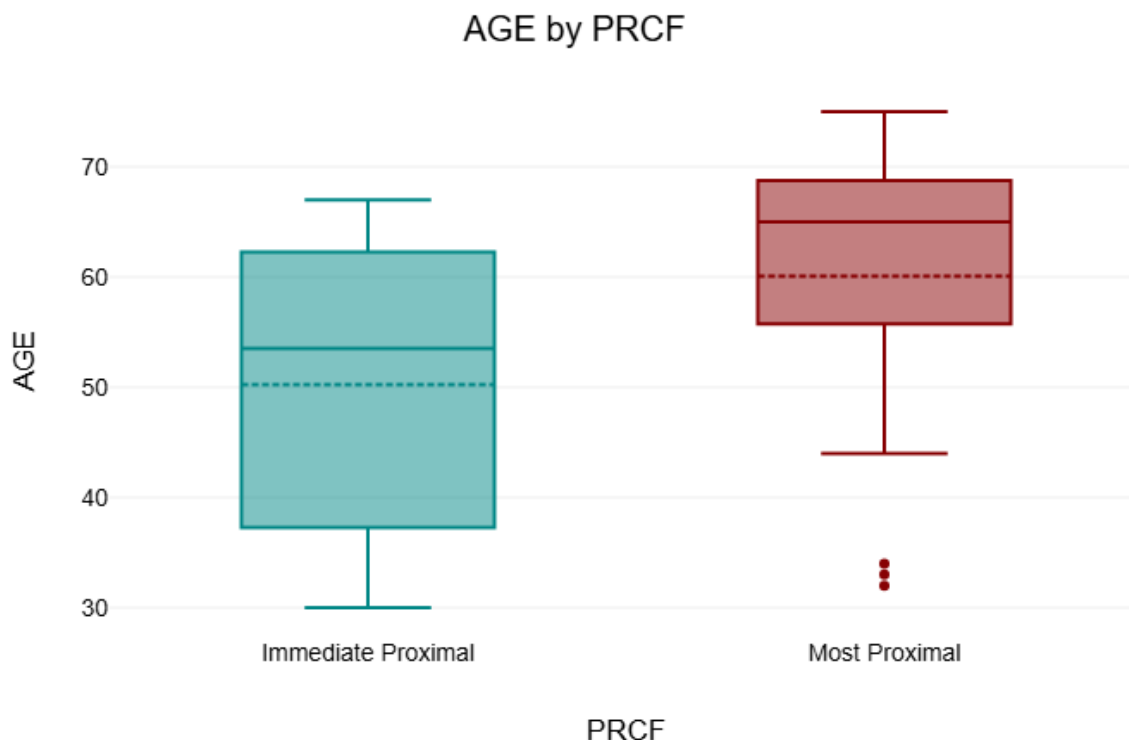
|  |  | Frequency | Mean ± Std. |
|---|---|---|---|
| AGE | Male | 20 | $54.65 \pm 14.21$ |
|  | Female | 10 | $63.1 \pm 12.84$ |

The mean age of the females was significantly higher than that of the males. ($p$-value $<0.001$).
In the PRCF group, we observed that most of the anastomosis was proximal, noted in 72.33% of cases.
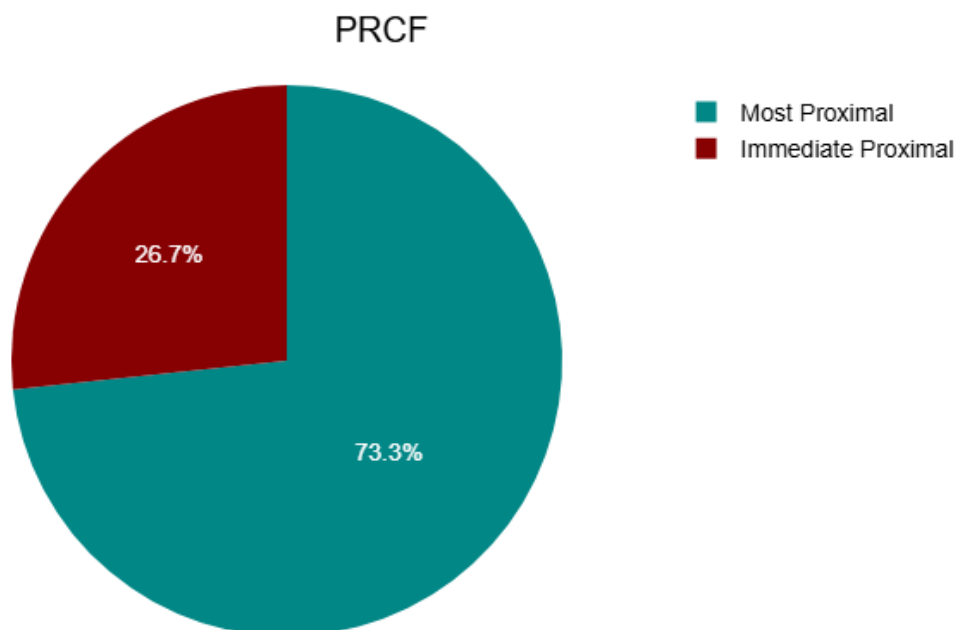


When we compared the age variation, we didn't find any difference between the two types of PRCF. (p value 0.092)

In both cases, early failure was due to thrombosis. Late Failure was seen in two patients due to pseudo-aneurysm formation. Oedema, found in 2 cases of PRCF as an early complication, subsided by simplelimb elevation.

Early failure rates were 7% in PRCF and 17.5% in DRCF. The patency rate was 83% in PRCF and 70% in DRCF.



Late Complications were due to luminal narrowing due to intimal hyperplasia, which can be treated by angioplasty. In our study, two cases had this late complication, which was not subjected to angioplasty. Aneurysm formation was the second late complication. There was a total of two cases of such complications. One was a Serpentine dilatation, and another was a pseudoaneurysm due to infection, which was blown out and, hence, taken down and ligated.

**DISCUSSION:**
When a DRCF fails or is not feasible, most of the surgeons place an upper arm brachiocephalic fistula. This sequence sacrifices potential access sites in the forearm. The PRCF is an infrequently used option, which allows for identifying a second fistula in the forearm before proceeding to the upper arm. Little published literature has compared the short- and long-term outcomes of PRCF and DRCF.

The present study noted that early failure rates were 7% in PRCF and 17.5% in DRCF. The patency rate was 83% in PRCF and 70% in DRCF. In a study by Mishra et al., early failure was lower for PRCF than DRCF (6.06% vs 15%). The primary patency rate at one year was 87.87% in PRCF vs 70% in DRCF. [8] The findings of the present study were similar to Bhalodia et al.

The current study and that conducted by Mishra et al. reported no instances of steal syndrome in either the PRCF or DRCF groups.

The primary failure rate for proximal AVF was 20%, whereas for distal AVF it was 28%. [4] Our findings surpass those of the prior study conducted by Al-Jaishi et al. Lower primary failure may be ascribed to a greater diameter of the proximal artery compared to the distal radial artery. The vessels with larger diameter promote increased flow and reduce failure rates. [8,23]

Mishra et al. identified thrombosis and maturation failure as causes of early failure, occurring at a rate of 6.06%.
Previous guidelines have suggested BCF as the next option for DRCF failure. Recent studies by Arnoutakis et al. have favoured proximal PRCF over BCF. [9]

PRCF has a higher patency rate than DRCF, lesser complication than BCF, and equal or similar long-term patency rates as BCF. So, we recommended PRCF in failed DRCF as the next option before BCF.

**CONCLUSION**
Proximal radiocephalic fistulas (PRCF) are a viable option to brachiocephalic fistulas for individual's ineligible for distal radiocephalic fistulas (DRCF). Compared to DRCF, PRCF exhibit a much reduced primary failure rate and comparable cumulative survival rates, excluding first failures. In specific cases, the establishment of a PRCF may postpone the necessity to advance to the upper arm.

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