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*Original Article*

# Assessment of Post-Operative Complications after Radial Recurrent Artery Flap for Management of Wound Coverage in and Around the Elbow Region

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***Abstract***

*Complex elbow wound management is a common issue of reconstructive surgery which deals with burns (electric and flame burn), road traffic accidents (RTA), machineries and industrial accidents, tumor excision, the release of post-burn scar contracture, complications related to orthopedic reconstruction etc. A stable soft tissue cover is required for reconstructive purposes for such wounds management. In this ground surgeons apply suitable procedure and consider wound aetiologies to meet better outcome. Surgeons also permit the early elbow mobilization to preserve a range of motion after complex elbow wound management. Radial recurrent artery flap, in particular, provides durable coverage for medium-sized elbow defects as well as an early range of motion of the elbow joint. Some complications like marginal and partial flap necrosis are observed in some of the cases. The aim of the study was to assess the clinical outcome and complications after radial recurrent artery flap for the management of wound coverage in and around the elbow region. This is a prospective type of observational study conducted in the Department of Plastic Surgery, Dhaka Medical College and Hospital (DMCH), Dhaka. There were selected 20 patients according to inclusion and exclusion criteria over 17 months from October 2016 to February 2018. The patients were kept under follow-up of at least 2 months postoperatively. Findings of observation were recorded in a preformed data collection sheet and all data were compiled in a master table. Statistical analysis of the results was obtained by using statistical package for social science (SPSS), version- 17. In this study, the mean age of the patients was 25.4 years. The age range was 05 years to 50 years. Maximum patients (40%) were in age group 16 to 25 years. Among the injured patients, male – female ratio was 4:1. More than half of the injuries (55%) were caused by electric burn; other injuries were trauma (15%), flame burn (10%), contact burn (05%), and 15% by different causes. Radial recurrent artery flap was used to cover the cubital fossa in 13 patients (65%), the posterior aspect of the elbow in 5 patients (25%) and amputation stump in 02 patients (10%). The cubital fossa was the most used site in 15 patients. Here, the mean dimension of the wound was 80.28 $cm^2$ and the mean dimension of the flap was 70.43$cm^2$. Among 20 patients, 16(80%) patients showed no complication, marginal flap loss in one patient, partial flap necrosis in two patients, and total flap loss in one patient were observed. No history of graft loss and the donor site of the skin graft healed well. One case showed marginal flap loss, which is managed conservatively and healed by secondary intention. Two cases showed partial flap loss and another case showed total flap loss which is managed by excision of non-viable part followed by STSG. In 17 (85%) cases donor sites of flaps are closed primarily. One patient (05%) needed primary closure and STSG. Two patients (10%) needed STSG to cover the donor site. In most of the cases, about 80% showed excellent outcomes. Good outcomes in three cases (distal marginal and partial flap loss) and poor outcomes in one case (total flap loss) were observed. This study showed that Radial Recurrent Artery Flap is a good option for coverage of soft tissue defects in and around the elbow joint. It is a single-stage procedure allowing early mobilization and thereby preventing stiffness of the elbow joint. It also showed the rise of some complications that might be uncomfortable for patients.*

***Keywords:*** *Radial recurrent artery flap, elbow joint, STSG (split thickness skin graft).*

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## INTRODUCTION

Open soft tissue abnormalities around the elbow joint are frequently observed as a result of burns, trauma, internal fixation of complex fractures, and the relaxation of post-burn contractures. Stable coverage is necessary because these conditions often expose functionally significant tissues such as blood vessels, nerves, bones, and tendons. Although both local and free flaps can be used to address these problems, local flaps are typically preferred over muscle flaps with skin grafts. Local flaps require less operative time and provide a more aesthetically pleasing tissue match in terms of both color and texture. However, there are few local axial flaps suitable for use in the elbow joint, making these abnormalities particularly challenging to reconstruct. For anterior and posterior elbow lesions, the radial recurrent artery (RRA) flap offers a flexible and reliable option. The primary benefits of this flap include its consistent axial pedicle, simplicity of dissection, favorable aesthetic outcomes, and the ability to perform a quick, one-stage operation that avoids long-term immobilization of the affected elbow joint. Importantly, this procedure does not involve the sacrifice of a major artery or nearby muscle.[1] The radial artery (64%), the area just below the elbow joint, or the distal portion of the brachial artery (18%) are the most common sources of the RRA.[2] It supplies the extensor carpi radialis longus, extensor carpi radialis brevis, and the elbow joint as it ascends between the branches of the radial nerve, lying first on the supinator and then between the brachioradialis and brachialis, anastomosing with the RCA. Additionally, it provides skin coverage over a portion of the arm's lateral surface.[3] At the cubital fossa, the radial nerve splits into deep and superficial branches. The radial portion of the dorsal hand is innervated by the superficial branch of the radial nerve (SBRN), which is a sensory nerve.[4] One significant effect this anomaly may have on the radial free forearm flap (RF) is that it may cause the RA to flow more superficially in the forearm, making it susceptible to injury through the proximal skin cut.[5] Malperfusion may occur in the proximal skin paddles, and it is not always possible to rework the skin paddle in the middle of the casing. When designing a flap paddle, the surgeon should first establish the anatomy of the RA through proximal pedicle exploration if a proximal skin paddle is required.[6] However, the RF flap donor site has several drawbacks, including loss of skin graft, impaired motor function, and sensory disruption. Specifically, sensory disruption can lower patients' quality of life after surgery. Patients frequently report paresthesia and/or discomfort following damage to the SBRN during RF flap harvest. These symptoms seldom interfere with daily activities and are often temporary unless the SBRN is completely removed. However, some patients experience chronic neuropathic pain that lasts a lifetime. Additionally, patients with paresthesia who are young and active have a significant chance of suffering another injury. Due to diminished sensibility, there is a risk of contact burn on the dorsal hand.[4] Therefore, it is critical to minimize sensory disruption during RF flap harvest.

## METHODS

This was a prospective type of observational study done in the Department of Plastic Surgery, Dhaka Medical College and Hospital, Dhaka. Patients were selected according to inclusion and exclusion criteria over 17 months from 1st October 2016 to February 2018 where the sample size was 20. Wounds in and around the elbow resulting from a burn, tumor excision, trauma, post-burn contracture release, etc. necessary for flap coverage were among the inclusion criteria. Patients with potential injuries to the pedicle of the donor site due to previous trauma or surgery, and patients with significant co-morbid conditions either with psychiatric disorders or with polytrauma and other life-threatening injuries were excluded from the study. The patients were kept under follow-up of at least 2 months postoperatively. Findings of observation were recorded in a preformed data collection sheet and all data were compiled in a master table first. Statistical analysis of the results was obtained by using a statistical formula and calculator. Statistical analysis of the result obtained by using Windows-based computer software devised with Statistical Package for Social Science (SPSS-17).

## RESULTS

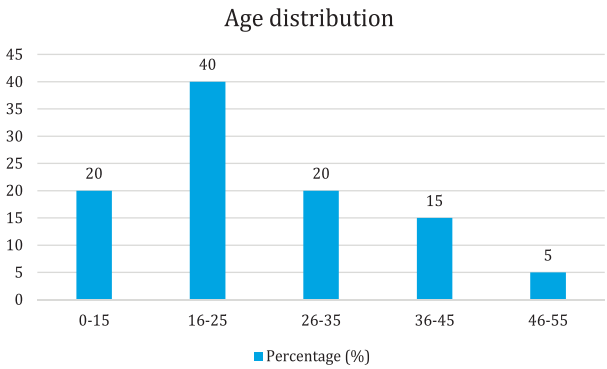


**Figure- 1:** Age distribution of the participants (N=20)

Figure 1 illustrate the age distribution of the participants; among them the mean age was 25.4 years. Here, 40% was within the age group of 16-25 years, while 20% was under 16 years of age and another 20% was in age group of 26-35 years.

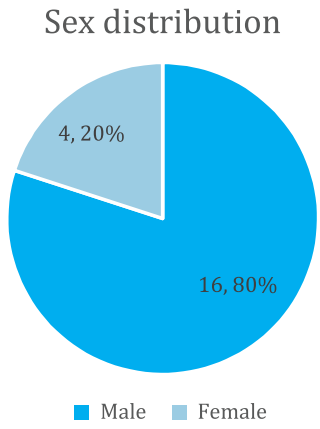


**Figure- 2:** Gender distribution of the participants (N=20)

Figure 2 represents the distribution of sex of the participants, where 80% of the participants were male and rest of them were female.

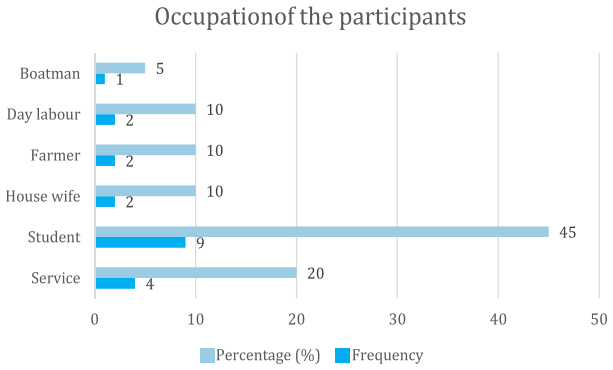


**Figure- 3:** Distribution of the participants by occupation (N=20)

Figure 3 state the distribution of the participants by occupation; 45% of the participants was students, where 20% was service holder. Day laborer, farmer, and housewife each of them held 10% of the study population.

Table I shows the distribution of patients by cause of injuries; here, 55% of the injuries happened due to electric burns. Other injuries caused by trauma 15%, flame burn 10%, contact burn 05%, tight plaster 05%, the release of post-burn scar contracture 05% and excision of squamous cell carcinoma 05%.

**Table- I: Distribution of patients by cause of injury (N= 20)**

| Cause of injury | Frequency | Percentage (%) |
|---|---|---|
| Electric burn | 11 | 55 |
| Trauma | 3 | 15 |
| Flame burn | 2 | 10 |
| Contact burn | 1 | 5 |
| Tight plaster | 1 | 5 |
| Release of post-burn scar contracture | 1 | 5 |
| Excision of squamous cell carcinoma | 1 | 5 |

Table II contains the sites of wound, dimension of wounds and also dimension of flaps. Here 65%, 25% and 10% wounds were in the site of cubital fossa, posterior aspect of elbow and amputation stump respectively. In mean dimension of wounds was 80.8 $cm^2$, where length was 11.28 cm and width was 7 cm. The mean dimension of flaps was70.43$cm^2$ where length was 13.3 cm and width was 5.28 cm.

**Table- II: Site of wounds, dimension of wounds and flaps (N=20)**

| Variables | Number of Patients | Percentage |
|---|---|---|
| Site of wound | | |
| Cubital fossa | 13 | 65% |
| Posterior aspect of elbow | 5 | 25% |
| Amputation stump | 2 | 10% |
| **Mean dimension of wounds** | **Measurement** | |
| Length | 11.28 cm | |
| Width | 7 cm | |
| Wound | 80.8 $cm^2$ | |
| **Mean dimension of flaps** | **Measurement** | |
| Length | 13.3 cm | |
| Width | 5.28 cm | |
| Flap | 70.43 $cm^2$ | |

Table- III shows distribution of patient by postoperative complication, where 10% of complications were found to be partial flap necrosis; each of the marginal and total flap necrosis was found in 05% of patients.

There was no history of graft loss. Donor sites of flaps and skin grafts healed well and 80% of patients showed no complications.

**Table-III: Distribution of patient by postoperative complication (N=20)**

| Complication | Frequency | Percentage |
|---|---|---|
| Marginal flap necrosis | 1 | 5 (%) |
| Partial flap necrosis | 2 | 10 (%) |
| Total flap necrosis | 1 | 5 (%) |

Table IV states the management of complications 01 case showed marginal flap loss which is managed conservatively and healed by secondary intention. 02 cases showed partial flap loss and another case showed total flap loss which is managed by excision of non-viable part followed by STSG.

**Table-IV: Management of complications (N=20)**

| Complication | Management | Frequency | Percentage |
|---|---|---|---|
| Marginal flap loss | Excision & secondary healing | 1 | 5 |
| Partial flap loss | Excision and STSG | 2 | 10 |
| Total flap loss | Excision and alternate method of reconstruction | 1 | 5 |

In Table V contains the distribution of patients by mode of donor site closure 17 (85%) cases of donor sites of flaps are closed primarily, 01 patient (05%) was needed primary closure and STSG and 02 patients (10%) were needed STSG to cover the donor site.

**Table- V:** Distribution of patients by mode of donor site closure (N=20)

| Closure | Frequency | Percentage (%) |
|---|---|---|
| Primary closure | 17 | 85 |
| Primary closure +STSG | 1 | 5 |
| STSG alone | 2 | 10 |

Table VI represents the distribution of results by reconstruction; here 16(80%) cases showed excellent outcomes, good outcomes in 03 cases (distal marginal and partial flap loss) and poor outcomes in 01(5%) case (total flap loss).

**Table-VI: Distribution of results by reconstruction (N=20)**

| Outcome | Criteria | Percentage (%) |
|---|---|---|
| Excellent | Excellent flap adhesion, no infection, no flap loss | 80 |
| Good | Distal marginal flap loss, partial flap loss, hypertrophic scar over donor site | 15 |
| Poor | Complete flap loss requiring alternate procedure, wound dehiscence over donor site and subsequent ugly scar | 5 |

## DISCUSSION

In this study, the mean age of the patients was 25.4 years, with an age range from 5 to 50 years, where the majority of cases were between 16 to 25 years of age. Similarly, Ashfaq F. et al. used a reverse lateral arm flap with an age range from 13 to 30 years and a mean age of 23.8 years.[7] A study by Khaled M.S. et al. also illustrated reverse lateral arm flaps for elbow coverage with an age range from 7 to 50 years, closely aligning with our study. When considering gender, male predominance was observed in our study, with 80% of the 20 patients being male and 20% female. Similarly, Khaled M.S. et al. showed 54% male prevalence in their study, where out of 30 cases, only 46% were female.[8] The etiology of soft tissue defects in this study included electric burns, trauma, flame burns, and others. Among these, electric burns and trauma were the primary reasons for reconstruction, accounting for 55% and 15% of cases, respectively. The etiology in the study by Tiernan E., Healy C., et al. included trauma, cutaneous malignancy excision, and radial forearm free flap donor defects, while Khaled M.S. et al. used distally based lateral arm flaps to cover elbow defects caused by electric burns, trauma, release of post-burn scar contracture, and other reasons.[8, 9] This study used the flap to cover the cubital fossa in 13 cases, the posterior aspect of the elbow in 5 cases, and the amputation stump in 2 cases. Similarly, the study by Tung TC et al. used this flap in 7 patients for the reconstruction of posterior soft tissue defects of the elbow, and another

study by Culbertson JH et al. used this flap to cover the cubital fossa in a patient.[10, 11] Here, the study shows that the cubital fossa was the most frequently used site in 13 patients. The wound length averaged 11.28 cm and the width 7 cm, with a mean wound dimension of 80.8 $cm^2$. The flap length averaged 13.3 cm, the width 5.28 cm, and the mean flap dimension 70.43 $cm^2$. Prant IL. et al. used this flap for wound sizes of 4 to 10 cm and an average wound area of 30 to 80 $cm^2$, closely matching our findings.[12] Among the 20 cases in our study, no complications were observed in 16 cases. Marginal flap loss occurred in one case, partial flap loss in two cases, and total flap loss in one case, which were managed by excision of the non-viable part followed by split-thickness skin grafting (STSG). Similarly, Khaled MS et al. showed that out of 30 cases, there was marginal flap loss in 3 cases, significant flap loss in 2 cases, complete flap loss in 2 cases, and no loss in 23 cases.[8] In 17 patients (85%), the donor site was primarily closed. Two patients required STSG to cover the donor site, and one patient required primary closure and STSG. There was no discernible donor site morbidity, such as unstable scars, hypoesthesia, or hypertrophic scars. Khaled MS et al. noted donor site morbidity such as stretched scars, hypertrophic scars, and hypoesthesia in a few of his cases.[8] In our study, 16 cases showed excellent outcomes, three cases (with distal marginal and partial flap loss) showed good outcomes, and one case showed poor outcomes (total flap loss). Lai CS et al. reported uneventful postoperative outcomes, satisfactory cosmetic results at both donor and recipient sites, and normal elbow function in their study.[12]

*Limitations of the Study*

The maximum dimension of the flap was not adequately assessed. The increased range of motion of the elbow joint due to the operation or physiotherapy was also not distinguished. The study was conducted in a single hospital with a small sample size, which may not fully represent the actual results.

## CONCLUSION

The radial recurrent artery flap proved to be dependable and durable, with no donor site morbidity. This is a good substitute when reconstructing a small to moderate-sized elbow defect that requires a thin, flexible flap. The range of motion of the elbow joint is guaranteed and influenced by early postoperative exercise. Some limitations (small flap size, limited vascular caliber) are still there to solve and some complications such as loss of skin graft, impaired motor function, and sensory disruption, chronic neuropathic pain may be observed in some of the cases while managing wound coverage in and around the elbow region. Apart from that, it's a useful option for addressing defects in the elbow region.

**Ethical approval:** The study was approved by the Institutional Ethics Committee. Confidentiality was maintained. Permission was taken from the department and institution to perform the study.

## RECOMMENDATION

The findings of this study may be a demonstration of radial recurrent artery flap for management of wound coverage in and around the elbow region. The findings of this study will guide the surgeons for more accurate assessment of the outcome. Larger sample size and multi-centered data with sufficient period time are required for further study and better outcome.

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