Original article

Free Flap Reconstruction in Pediatric Patients – A Seven Years Single Institutional Experience

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ABSTRACT

Background: Microvascular surgery in the Pediatric age group is challenging due to technical difficulties in dealing with comparatively smaller vessel size. However, with enhanced magnification and better training, expertise in this area is improving.

Methods: A retrospective record review of all Pediatric patients who underwent microvascular reconstruction for various indications was undertaken. This study was performed at a tertiary care referral centre over a seven-year period (August 2010 to July 2017). Children under the age of15 years were included. Demographic profile, indications, operative records and outcomes were retrieved and analysed. Our experience in such cases and outcomes are presented.

Results: Records of a total of 48patients were identified and included in this study. The mean age was 9.5 years. Defects were most commonly located over the head and neck (n=24), followed by lower extremity (n=19) and upper extremity(n=5). The free flap was chosen based on the need and availability of tissue on a case-per-case basis. Re-exploration was required in 5 cases and complications occurred in 7 cases. The overall success rate was91.67%.

Conclusion: Microvascular surgery in children is safe and reliable. Considerably improved outcomes have been recently reported. The indications, success and complication rates are almost identical to adults. Availability of experienced surgical team, which has been a major hurdle, is now increasing available. Knowledge of multiple reconstructive options and mastering them of them seems essential for consistent results.

Key words: Pediatric; free flap; reconstruction; microvascular surgery

INTRODUCTION

Microsurgery is now a frequently used procedure in adults with success rates around 91-99 %[1]. Despite an early report in 1964 about successful arm replantation in a 12-year-old boy, surgeons remain concerned about the feasibility of microsurgery in young children. Malt and McKhann in 1964 did their first microvascular surgery in children in the form of successful arm replantation[2]. Through sporadic publications in the 70s, it was apparent that microsurgery in children was a possibility.[3,4] Literature in the mid-80s improved by larger series which explain the suitability of performing a variety of microvascular surgeries in children[5,-8].

The basic principles of microvascular surgery are almost similar in both adults and children. However, microvascular reconstruction in Pediatric patients has only lately gained wider acceptance after doubts about the technical utility and reliability of the procedure were resolved. The absence of associated comorbid factors and better recovery compared to adults are positive points, but the technical challenges remain[9].We studied Pediatric patients undergoing microvascular free flap surgery for various indications at our institute. Outcomes and our experience in dealing with these cases are summarized.

MATERIALS AND METHODS

Medical records of all patients under the age of 15 years who underwent free flap reconstruction at our institute over a duration of seven years (August 2010 to July 2017) were retrospectively retrieved. This study was conducted at the Department of Plastic and Reconstructive Surgery, Sawai Man Singh Medical College and Hospital, Jaipur, a tertiary care referral centre in North India. Other forms of microvascular surgeries such as replantation, vascularized lymph node transfer, etc were not included in this study. Demographic profile, indications for surgery, intraoperative details and postoperative outcomes were retrieved and analysed.

The study was approved by the institutional Ethics Committee and was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and all its later amendments. Informed consent was obtained from parents or legal guardians of all patients included in the study.

Preoperative computerized tomographic angiography (CTA) was performed in all cases of trauma to ascertain vessel condition. All procedures were performed under general anaesthesia. After recipient site was prepared, vessels identified and flow ascertained, meticulous flap harvesting was done followed by inset and anastomosis. The entire reconstructive procedure was performed under magnification by a single team and the operative time was recorded. One artery and at least one vein were anastomosed in all cases. Nylon 9-0 or 10-0 interrupted sutures were used depending on vessel size and operating surgeon's preference.

A bolus of heparin (80 IU/kg) was given at the beginning of anastomosis which was repeated postoperatively at a dose of 18 IU/kg in two divided doses for anticoagulation on the first three postoperative days. From day 3, oral antiplatelet combination drugs (aspirin + clopidogrel) were started and continued for 3 months. Postoperatively, patients were nursed in the intensive care unit (ICU) and flaps were monitored by clinical evaluation. Analgesics and antibiotics were given on a case by case basis.

In cases of mandibular reconstruction, feeding was initiated by Ryle's tube after 24 hours and gradually shifted to oral intake over 2 weeks. The patient was kept intubated for 24 hrs. Drains were removed when drainage was less than 10 ml over 24 h. Whenever feasible, ambulation was encouraged as early as possible except in cases where the fibula was harvested, in which case the patient was encouraged to walk with support after 10 days. Representative cases are shown in Figure 1 and 2.

RESULTS

Forty-eight patients (31 male, 17 female) had undergone free flap reconstruction over seven years and were included in the study. The age of the patients ranged from 2 to 15 years (mean 9.5± 3.6 years). Surgeries were performed for various indications, all of them being elective in nature. Mandibular reconstruction following tumour resection (n=22) was the commonest indication, followed by reconstruction of lower extremity secondary to trauma (n=16) and chronic osteomyelitis (n=5), scalp reconstruction following traumatic avulsion (n=2), reconstruction of post-burn deformities involving forearm (n=1) and cheek (n=1), and reconstruction of encephalocele (n=1).

Figure 1: Photograph of child with mandibular tumor showing a) preoperative appearance, b) CT scan showing mandibular lesion, c) intraoperative photograph showing lesion, d) resultant defect following excision, e) sculpted fibula flap following fixation, and f) postoperative appearance

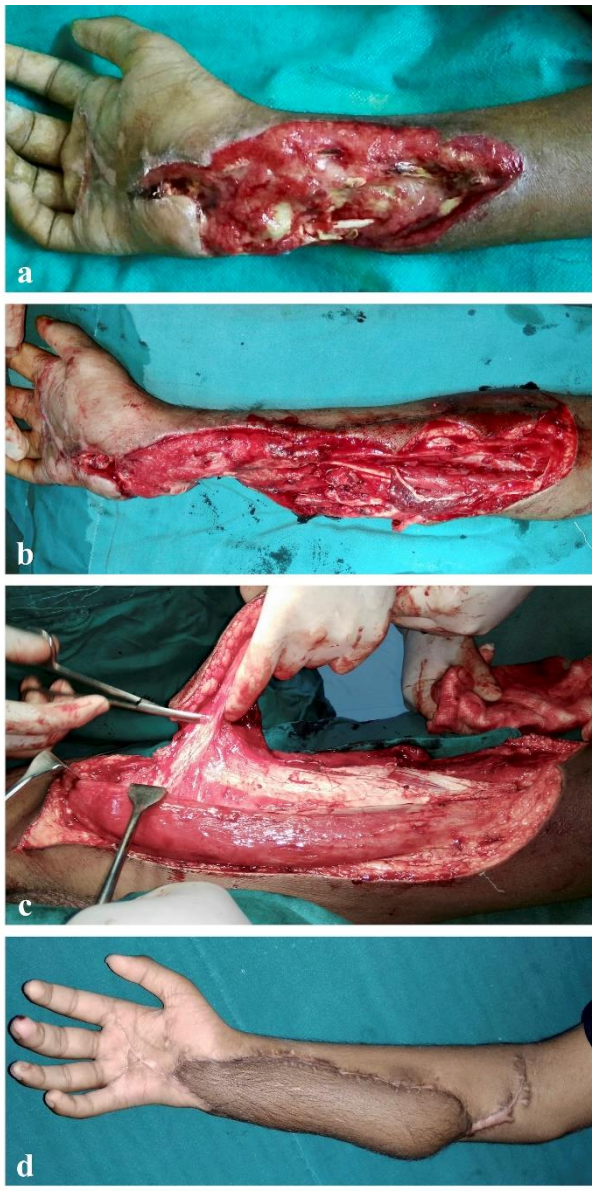

Figure 2: Photograph of patient with post electric burn defect of the right-hand showing a) preoperative appearance, b) resultant defect after debridement, c) elevation of free ALT flap, and d) postoperative appearance

Free flaps employed for reconstruction were fibula osteocutaneous (FOC) flap in 28 patients, anterolateral thigh (ALT) flap in 10 patients, latissimusdorsi (LD) flap in eight patients and radial artery forearm (RAF) flap in two patients. Arterial anastomosis was done end-to-end in 44 cases and end-to-side in four cases (one LD and three ALT flaps for leg defects); venous anastomosis was end-to end in all cases. The mean operative time (excluding the time needed for recipient bed preparation and/or tendon reconstruction) was 198 minutes (range 150-230 minutes).

All cases with mandibular defect were managed with free fibula flap. Double skin paddle reconstruction was performed in three cases (13.5%). Among the remaining 19 cases with single paddle, the skin island was used only for monitoring in 12 cases.

As a general rule, tension-free primary closure was attempted at the donor site whenever possible; split skin grafts were used to manage the rest.

The overall success rate was approximately 92%. Five patients - two ALT flaps for coverage of lower extremity defect, two FOC flap for mandibular defect and one LD flap for coverage of heel defect - required re-exploration within 12 hours of surgery for venous congestion (n=3) or arterial insufficiency (n=2). Anastomoses were revised in all cases. Only one flap (FOC flap for mandibular defect) could be salvaged. Failed FOC flap for mandibular defect was managed by pectoralis major myocutaneous flap, and the rest were managed with cross leg flap.

Complications were noted in seven patients (14.6%) - donor site hematoma in two patients, donor site infection in two patients, skin graft loss over recipient site in two patients and marginal necrosis one patients. Loss of skin graft was managed by secondary grafting, while the rest were managed conservatively.

The length of stay in the hospital ranged from 8 to 20 days (mean 12.2 ± 3.18 days). Extremity restraints and immobilization splints were used to protect the recipient site and decrease pain. The postoperative follow-up period ranged from 4 months to 3 years with mean of 13.2±1 month.

DISCUSSION

The use of free flaps for reconstruction in Pediatric patients has been relatively delayed as compared to adults. Initially, microvascular surgery was deemed impossible because of technical difficulties due to smaller sized vessels. With time and experience, however, technological advancement in surgical instruments and operating microscopes coupled with keen training in this area have made it possible.[4,10-12].

Theoretically, there are a couple of factors which render microsurgeries children more successful– firstly, relative size of the vessels when compared with muscle mass is greater than that of adults, and secondly, incidence of comorbidities is significantly low in Pediatric patients.

Vasospastic property of Pediatric vessels, though, remains a controversy.[8,13] Evidence from literature points to the belief that Pediatric vasculature is resistant to thrombosis and vasospasm and a possible explanation is the underdeveloped muscularis layer.[9,14] To reduce the risk of spasm at our institute, attention is paid to meticulous dissection while harvesting, minimum ischemia time, delicate handling and avoidance of multiple passes through vessel wall. The vessels are also constantly bathed and irrigated with 2% lignocaine and heparin during surgery. No problems of vessel spasm were experienced in the postoperative period in this study, although transient

vasospasms were noticed intraoperatively, which is not uncommon.[8,15-17]

Literature seems to be divided over the postoperative use of anticoagulants in the Pediatric age group. While few authors suggest complete abstinence, others suggest customized protocol of anticoagulation.[14,15,18] Shapiro et al[16] deems systemic anticoagulation unnecessary, although they routinely used aspirin for 2 weeks postoperatively. Canales et al.[8] used dextran and aspirin without significant adverse effect. Banic and Wulff[19] used anticoagulants only after revision of vessels in their patients. In our series, we used the anticoagulants routinely and have found it to be beneficial. No adverse effects were encountered.

In our study, main indications were for coverage of defects following tumour resection, trauma, osteomyelitis, burns, scalp avulsion and congenital deformity, in that order. In other reports among Pediatric populations, the indications were similar albeit with varying frequency.[8,18,20,21]

Historically, a high failure rate was common in children, but the success rate has drastically improved in recent times.[2,9,11,22]. Our success rates have gradually improved over the years due to improvement not only in technology but also in our own experience in such cases. The average success rate of this study stands at 92% which we consider to be comparable to prevailing reports in literature.[23]

In Pediatric patients, suitable donor sites are scarce because of the need for a long and reliable vascular pedicle of sufficient size.[11,24,25] Free FOC flap provides a sufficiently long pedicle and, incidentally, was the most frequently used flap in this study as mandibular defects were the most common indication. Donor site morbidities were minimal and most of them resolved spontaneously with local wound care. The rate of donor site complications is comparable to, or even lesser than, the adult population as mentioned in few case reports.[5,6,26]

Despite the fact that microvascular surgeries in Pediatric patients may be lengthy, they tolerate anaesthesia better than adults[i ii].[27,28] In our study, the mean operative time was acceptable and not significantly higher than that in adults at our institute. This time, however, can be decreased by a two-team approach whenever possible.

Postoperative care is very essential for successful outcome of Pediatric microvascular surgery. The uncooperative behaviour of some Pediatric patients may sometimes lead to complication related to immobilization such as loss of split skin graft, donor site hematoma or anastomotic failure. We use customized splints and restraints to achieve immobilization. The average hospital stays in this series which was 12.23 days (range 8 to 20 days) is comparable to the other published series (9–31 days) [8,10,14,29,30]

The rate of complications in Pediatric series of free tissue transfer in the literature varies from 2 to 62 % .[8,9,14,31] In our series, a total of 12 complications occurred in 48 patients (25%), including flap failure or re-exploration.

Khouri, after evaluating clinical experience of nine microsurgeons, concluded that operative experience is the single most critical factor related to improved success rates.[32] That notwithstanding, there are other factors such as quality of instruments and microscopes that also play an equally important role in developing countries. Further, expertise in this field needs to be actively disseminated to equip future generations of reconstructive surgeons and increase the reach and impact in society.

CONCLUSION

Microsurgery is now a standard of care in adults. Improvements in technology and an increase in expertise have gradually helped eliminate problems related to its application in children. Results from this study further add evidence regarding safety and feasibility of Pediatric microsurgical reconstruction in a variety of indications. Particularly, attention is drawn towards meticulous handling of vessels, optimal postoperative care and reduced operative time. Critical determinants for success also include an experienced surgical team and support staff, good instrumentation and suitable magnification.

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