A Comparative Study on Microvascular Anastomosis of Vascularised Free Fibular Flap with Couplers and Suturing in Mandibular Reconstruction

Senthil Murugan^{1,2} · Reena Rachel John³ · V. B. Krihnakumar Raja¹ · Ajay Mohan¹ · Lokesh Bhanumurthy⁴

Received: 20 March 2014 / Accepted: 25 September 2015 / Published online: 17 November 2015
© The Association of Oral and Maxillofacial Surgeons of India 2015

Abstract

Introduction Successful outcome of any vascularised free flap basically depends upon the successful restoration of circulation in the flap after anastomosis. As the flap ischemic time is the significant factor which determines the outcome of any free flaps, due consideration is given to reduce the time for anastomosis for reperfusion. The present study compares and evaluates whether the usage of microvascular couplers with the conventional suturing reduce the ischemic time of the free flaps.

Materials and Methods Thirty patients were randomly divided into two groups (each group consisting of 15 patients) for mandibular reconstruction using free fibular microvascular flap. In group 1, microanastomosis was done with conventional suturing whereas microvascular couplers were used in group 2. Intraoperatively, patency, leakage and tissue perfusion were assessed. The time taken for anastomosis (time taken for suturing and applying couplers) and flap ischemic time (from the time of flap division from the donor site till the flap is reperfused after anastomosis) were calculated for both the groups.

Results Significant decrease in time for anastomosis was observed in group 2, which resulted in decrease in flap ischemic time and in overall operating time.

Keywords Microvascular surgery · Reconstructive microsurgery · Free flaps · Microvascular anastomosis · Microvascular couplers · Mandibular reconstruction · Free fibular flap

Introduction

The outcome of microvascular surgery is determined by the restoration of circulation to the free flap. However, the intricacy of the anastomosis procedure itself may delay the circulation, leading to the need for flap salvage surgery. The commonest method of anastomosis is by the use of microsuture material such as 8/0 or 9/0 nylon. Several alternates have, however emerged in the past four decades, of which the most promising appears to be the use of microvascular couplers. It has been stated that microvascular couplers have patency rates as high as that seen with sutured anastomoses, while offering the advantage of decreased operating time and also able to anastomose small vessels [1].

The aim of this study was to compare two different methods of microvascular anastomosis. Anastomosis of vessels using conventional microsutures and using microvascular couplers were evaluated with regard to total time taken for anastomosis, patency of the vessels after anastomosis and period of flap ischemia.

Materials and Methods

Thirty patients (17 males and 13 females) who reported to the Department of Oral and Maxillofacial Surgery between December 2007 and February 2014. The age ranged from 13 to 54 years (mean age 31.1 years). All patients required

✉ Senthil Murugan
microsurgeonsenthil@gmail.com

¹ Department of Oral and Maxillofacial Surgery, SRM Dental College, Ramapuram, Chennai 600089, India

² DWIJAN Research Institute, F5, Whitefields, Victoryfield Extn, Alex Nagar, Madhavaram, Chennai 600051, India

³ Department of OMFS, VMS Dental College, Salem, India

⁴ Tagore Dental College, Chennai, India

mandibular reconstruction with free fibula microvascular flap.

The patients were evenly divided into two groups. In Group I, anastomosis was done with conventional suturing using 8/0 or 9/0 prolene. In Group II, the blood vessels were connected using microvascular couplers. All surgeries were performed by the same surgeon. For each surgery, the parameters recorded included the time taken for performing the anastomosis, total period of flap ischemia, leakage from the site of anastomosis and patency of the vessels.

Surgical Procedure for Anastomosis Using Coupler

The donor and recipient vessels were prepared by trimming any redundant adventitia from the end of the vessels. Heparinized saline, 4 % xylocard and papaverine were repeatedly used to flush the debris. The vessels were dilated and the diameter of each vessel was measured using a specially designed measuring gauge in order to determine the correct coupler size (Fig. 1). The coupler was chosen according to size. The coupler was loaded onto the application device and the two ends of the vessel were sequentially pulled through the rings without any twisting with the help of jeweller's forceps and everted over the pins (Fig. 2). Once properly attached without any visible foreign material inside the lumens, the anastomotic instrument was rotated clockwise until the final position of the coupler was achieved. A final check insured that the pins were lined up to meet the corresponding hole in its counterpart (Fig. 3). Their penetration was completed by a hemostat used to further crimp the two wings together to insure a friction fit of the pins into the holes. The anastomotic device was rotated till the shaft was released. The device was taken out and patency of the vessel was checked (Fig. 4).

Fig. 1 Measurement of vessel diameter

Fig. 2 Attaching the vessel end to the coupler pins

Fig. 3 Checking the alignment of coupler pins

Fig. 4 Final coupler in place securing the vessel ends

Results

Comparison of the parameters between the two groups yielded the following results.

Fig. 5 Comparison of anastomotic time between two groups

Fig. 6 Comparison of ischaemic time between two groups

Anastomotic Time

The mean anastomotic time in group I was 34.94 ± 2.9 min whereas the mean anastomotic time in group II was 12.52 ± 2.3 min (Fig. 5). This shows that the anastomotic time was significantly reduced in case of anastomosis using microvascular coupler (Fig. 5).

Ischemic Time

The mean anastomotic time in group I was 258.4 ± 16.9 min whereas the mean anastomotic time in group II was 188.2 ± 9.1 min (Fig. 6). This shows that there was a significant decrease in ischemic time when microvascular coupler was used for anastomosis (Fig. 6).

In all the patients, patency of the anastomotic site was found to be adequate and no leakage was encountered. The patients were evaluated post surgically at regular intervals to assess the outcome. The patients of both the groups were followed for 5 years and updated. Out of 30 patients, 29 achieved good functional and aesthetic outcome. One patient, belonging to group I, had a flap failure on the second post operative day.

Discussion

The coupler device system is available with inner diameters ranging from 1.0 to 3.0 mm at 0.5-mm intervals and can be applied successfully to vessels in the same range of sizes. Approved by the Food and Drug Administration, the coupler is the most commonly used non-suture anastomotic system. The device can be used without fear of foreign body reaction or long-term sequelae [2]. The coupling device has been accepted for use in venous, but not arterial, anastomoses. Morrit et al. [3] have observed vessel wall thinning following arterial coupling without noting any clinically significant sequelae. In our study arterial anastomosis was performed in all the five cases without any post-operative sequelae. Ross et al. [4] have reported a series of arterial anastomoses, in which only two coupled arteries thrombosed and none ruptured or developed pseudoaneurysms. Douglas et al. [5] described seven attempted arterial anastomoses for head and neck reconstructions but abandoned two secondary to perceived vessel wall thickness, impliability, and narrowed lumen diameter. In this prospective study there was a significant decrease in anastomotic time which in turn reduced the ischemic time and the total operating time in all the patients who had undergone anastomosis with coupler. The operating time was reduced by an hour on an average. There was no tearing of vessels or any thrombus formation. There was immediate refilling of the vessels without any leakage in all the five patients. The perfusion was good even in the follow up period. There was no flap failure in all the five cases. The application of microvascular anastomosis remains one of the most critical aspects of determining free flap survival, with technical errors accounting for a high proportion of failures. Efficient time management and safe performance of anastomosis minimizes the flap ischemia time and reduces the risk of inevitable complications. This study shows that a mechanical anastomotic device, when used appropriately, maybe as good as or sometimes even better than the conventional microvascular suturing. Traditionally sutured microvascular anastomoses have a failure rate of 2–5 %, and they remain the gold standard for comparison when considering alternative anastomotic methods. In this study, however, we had a higher success rate with the coupler rather than sutures, although the difference was insignificant.

The ability to perform suture anastomosis with confidence will likely remain a requirement for clinical microvascular surgery, due to the variable vessel conditions encountered in the operating room. Additional refinements of the coupler device may expand its scope in clinical microsurgery. An important consideration with respect to the operating technique is speed and efficiency. Anastomosis using microvascular coupler is much faster

than suturing and substantially decreases operating time. Although microvascular coupler is expensive, its advantages outweigh the cost. Based on this study we conclude that microvascular anastomosis using microvascular couplers are a safe alternative to conventional suturing technique in veins.

References

1. Ragnarsson R, Berggren A, Klintenberg C (1990) Microvascular anastomoses in irradiated vessels: a comparison between the Unilink system and sutures. *Plast Reconstr Surg* 85:412
2. Jeremic G, Shrimm M, Irish JC (2006) The microvascular anastomotic device and its role in free tissue transfer. *UTMJ* 8:51
3. Morritt N, Raine C, McLean NR (2002) The double-barrelled end-to-end microvascular anastomosis. *Br J Plast Surg* 55:64
4. Ross DA, Chow JY, Shin J, Restifo R, Joe JK, Sasaki CT, Ariyan S (2005) Arterial coupling for microvascular free tissue transfer in head and neck reconstruction. *Arch Otolaryngol Head Neck Surg* 131:891
5. Douglas AR, Ariyan S, Restifo R (2003) Use of the operating microscope and loupes for head and neck free microvascular tissue transfer. *Arch Otolaryngol Head Neck Surg* 5:129