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Retromolar Trigone Reconstructive Surgery: Prospective Comparative Analysis Between Free Flaps

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ABSTRACT

Purpose. Retromolar trigone (RMT) tumours are rare and aggressive malignancies, which require an aggressive surgical approach. The reconstruction oral cavity defects represent a challenge because of the critical role of this area both aesthetically and functionally. Free radial forearm (RF) or anterolateral thigh (ALT) flap are the first choice for the repair of intraoral defects. In reviewing the literature, there is lack of evidence pertaining to the differences between RF and ALT flaps in the reconstruction of patients with RMT tumours. This study evaluates the better microvascular reconstruction after RMT cancer resection.

Methods. Thirty patients with RMT cancer underwent oropharingectomy and microvascular reconstruction using the free RF flap (RF group) and the ALT perforator flap (ALT group). The two groups were homogeneous for sex, age, anatomic area, body mass index, and clinicopathologic profile. Viability, complications, scarring, cosmetic appearance, disorder of sensations, ROM, disease-specific items and satisfaction rate were analyzed, and statistical analysis was performed.

Study Design. Prospective study.

Results. There were differences between the RF and ALT groups in the morphofunctional outcomes, both short-term and long-term follow-up. These differences were statistically significant ($p < 0.05$) for donor site complications, cosmetic appearance, and scar evaluations. Manual dexterity was slower on the operated donor side than on the nonoperated side in the 33.3 % in the RF group.

Conclusions. The study showed that the free ALT perforator flap provides better results in appearance and scarring than the RF flap for intraoral reconstruction after RMT cancer resection.

Retromolar trigone (RMT) tumours are rare and aggressive malignancies.[1,2] Good oncologic outcomes can be achieved by advocating an aggressive surgical approach with postoperative radiation therapy.[1] Immediate free flap reconstruction surgery after cancer resection significantly influences a patient's quality of life.[3] Today, free radial forearm (RF) or anterolateral thigh (ALT) flap are the first choice for the repair of intraoral defects.[4] Nevertheless in reviewing the literature, no specific free flap seems superior.[5] Moreover, there is lack of evidence pertaining to the differences between RF and ALT flaps in the treatment of patients with RMT tumours. In this prospective study, we evaluated RMT reconstruction by analysis comparing the RF and ALT flaps, highlighting the surgical techniques, the complication rate, and the results, both functional and aesthetical.

METHODS

The study recruited a total of 30 patients with RMT tumour, from January 2008 to January 2013, which

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underwent cancer resection and immediate free flap reconstruction: 15 patients using the free RF flap (RF group) and 15 patients using the ALT perforator flap (ALT group). The patients were randomized for treatment allocation at a 1:1 ratio. The two groups were homogeneous for sex, age, anatomic area, and clinicopathologic profile.

The inclusion criteria were: no contraindications to the harvesting of microvascular free flaps, the patient's age was less than 80 years; patients had no previous or synchronous malignancies; ASA (American Society of Anaesthesiology patient classification status) 1–4. The study protocol conformed to the ethical guidelines of the Declaration of Helsinki. An informed consent for participation in the study was obtained from each patient.

All patients underwent radical excision of the cancer by oropharyngectomy, lateral or bilateral neck dissection, immediate free flap reconstruction, and adjuvant radiotherapy. All patients were afflicted with squamous cell carcinoma. No bone involvement was diagnosed. Tumour excision was performed through a transmandibular approach. In all patients, both hypoglossal nerves were preserved at the level of the digastric muscle above the carotid triangle.

In RF group, 15 patients were reconstructed using a free RF flap (Fig. 1), with the radial artery and cephalic vein pedicles—always three veins and in two cases four veins. According to Wong and Wei, all RF flaps were harvested through suprafascial elevation technique.[6]

In ALT group, 15 patients were reconstructed using an ALT perforator flap (Fig. 2), which is supplied by the descending branch of the lateral circumflex femoral artery. Always two veins were taken. In all ALT cases subfascial elevation technique was used followed by thinning of the flap when the defect was ready to be filled up with the flap.

All subjects enrolled in this study were assessed by a speech therapist before and after ablative surgery. Patients started a swallowing and speech rehabilitation program as soon as their clinical condition allowed correct receptivity, usually 1–2 weeks after surgical reconstruction.

Postoperative follow-up evaluation was at 7 days, and at 1, 3, 6, 12, and 24 months. We analyzed morphofunctional outcomes and early and late complications after reconstruction. Twelve months after surgery, we evaluated the formed scar was evaluated in terms of its pigmentation, colour, height, and elasticity on a numeric scale according to the Vancouver Scar Scale (VSS), both the donor and reconstructed sites. The cosmetic appearance of the reconstructed and donor sites was evaluated subjectively by the patients themselves based on a scale of 1 (cosmetic appearance close to normal) to 4 (unsatisfactory cosmetic appearance). Objectively, a blinded third-party observer evaluated the long-term aesthetic results. Moreover, to examine disorders of sensation, the discrimination of two points was evaluated using needles fixed by standard distance (two-point test). Functional results were also evaluated by questionnaire with disease-specific items (pain, activity, swallowing, chewing, speech, saliva, mood, social function) and satisfaction rate.

Definitively, to evaluate long-term quantitative donor-site morbidity following RF and ALT free tissue harvest, the patients were called between June and July 2014 for the ROM (range of motion) evaluation at the donor site. The nondonor side acted as a control for all patients. Without preoperative data, the contralateral nondonor site is very useful. Especially, quantitative outcome measures in RF group were: wrist flexion and extension, forearm pronation and supination, and hand dexterity. In ALT group, they were knee flexion and extension.

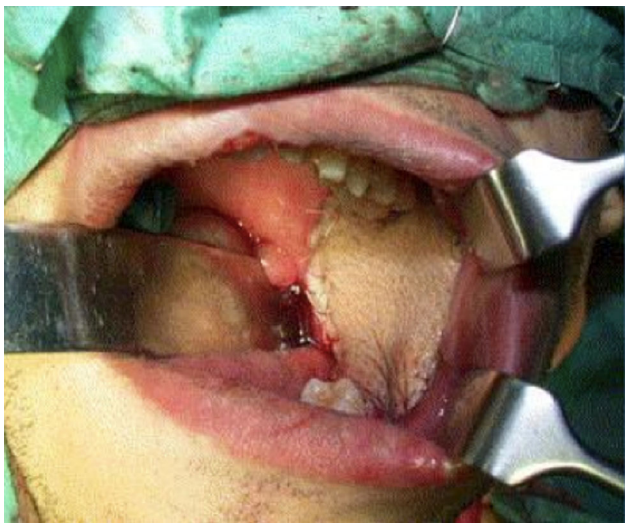

FIG. 1 Patient reconstructed using RF flap

FIG. 2 Patient reconstructed using ALT flap

Statistical Analysis

The Fisher's exact test was performed to compare discrete variables of the early and late complications as well as the cosmetic and functional outcomes for the two groups. A p value was considered significantly lower than 0.05. The software program used was Apache-open-office and In-silico-analysis©.

RESULTS

A total of 30 patients with RMT tumour participated in the prospective study of comparison between free RF and ALT flaps reconstruction; 73.33 % of patients were men and 26.66 % were women, 76.6 % of the sample smoked at inclusion, and 73.3 % patients had alcohol consumption at tumour diagnosis. Fifteen patients were assigned to the RF group and 15 to the ALT group. The two groups were homogeneous ($p > 0.05$). There were no significant differences in gender, age, body mass index (BMI), history, tumour location, and tumour stage between the two groups. There was difference between the RF and ALT groups in operation time (RF, 270 min ± 120 vs. ALT, 360 min ± 90).

During the short-term follow-up period (Table 1), the viability of the flap, the functions of the reconstructed oropharynx, and the early complications were analyzed. Minor flap complications, which did not require surgical revision, were observed in nine patients. Eight of these were in the RF group and the other in the ALT group. This difference in early complications between the groups was significant ($p < 0.05$). Total flap loss was occurred in one case of RF. Donor site of RF flap was repaired by full-thickness skin graft in all cases. Mean time for complete healing for the forearm donor site area was 3 weeks. Two forearm donor sites healed for second intention in approximately 30 % of the grafted area, probably due to intense tendon mobility. In the ALT group, there was a case of hematoma and dehiscence to the donor site. No other complications afflicted the donor site for ALT. Two weeks was the mean time for complete healing of the thigh donor area. No complication related to alteration of the vascularization occurred, such as vascular insufficiency, ischemia, congestion, or necrosis of the flap. No major complications included fistula formation and infection in the two groups (Table 1).

At the long-term follow-up (Tables 2, 3), we evaluated functional and aesthetic results of the reconstruction, scarring, and the late complications. In both the RF and ALT groups, we observed high preservation of the patient's oropharynx characteristics and normal function of the tissues. Evaluating the late complications of both the flap and donor site, we analyzed the deformity and/or defect, the disorder of sensation (Table 2), and the state of formed scars according to the VSS (Table 3). Moreover, the cosmetic appearance, functional outcomes, and satisfaction rate were assessed at long-term follow-up, both the reconstructed and donor sites (Table 2).

In the RF group, total late complications were 46.6 %, mainly dependent on the donor site. No complications afflicted the donor site for ALT. This difference was significant ($p < 0.05$).

In overall cosmetic assessment (reconstructed and donor sites), the subjective scoring showed that 40 % of the RF patients evaluated their appearance as good, 33.3 % as satisfactory, 13.3 % as very good, and 13.3 % as unsatisfactory. In cosmetic assessment of the reconstructed and donor sites, 60 % ALT patients evaluated their appearance as good, 33 % evaluated it as very good, and 6.6 % as satisfactory. The difference in cosmetic evaluation between the two groups was significant ($p < 0.05$). In the same way, the blinded third-party observer gave a favourable assessment for the ALT group that was significant to the statistical analysis ($p < 0.05$).

The differences between groups were not statistically significant for functional outcomes (pain, activity, swallowing, chewing, speech, and saliva domains) and satisfaction rate ($p > 0.05$). However, we point out the differences for the total of functional dysfunctions a long-term follow-up (Table 2). In the RF group, 8 of 15 patients (53.3 %) have referred 16 functional difficulties: 4 patients complained of difficult swallowing and social function; 3 patients complained of pain and difficult activity; 1 patient complained of difficult saliva and speech. In the ALT group, 4 of 15 patients (26.6 %) have complained of 8 functional complications: 2 patients referred pain and

TABLE 1 Evaluations at short-term follow-up

Group	Viability	Flap early complication			Donor site morbidity			Total	Mean healing time of donor site (week)
		Artery/Venous insufficiency	Ischemia/ Necrosis	Fistula/ Infection	Tendon exposition	Hematoma	Disorder of sensation		
RF	93.3 %	0	1	0	3	0	4	8	3
ALT	100 %	0	0	0	0	1	0	1	2
p value	>0.05	0.0033							>0.05

TABLE 2 Evaluations at long-term follow-up

Group	Late complication				Cosmetic appearance				Functional outcome								Satisfaction rate
					Subjectively				Blinded third-party observer								
	Flap or donor site deformity/ defect	Donor site disorder of sensation	Recurrence	Total	Very good	Good	Satisfactory	Unsatisfactory	Very good	Good	Satisfactory	Unsatisfactory	Pain	Dif. Activity	Dif. Swallowing	Dif. Chewing	Dif. Speech	Dif. Saliva	Dif. social function	Total	
RF	2	5	0	7	2	6	5	2	2	8	5	0	3	3	4	0	1	1	4	16	86.6 %
ALT	0	0	0	0	5	9	1	0	7	6	2	0	2	2	1	0	1	1	1	8	100 %
p value	0.0063				0.0115				<0.0001				>0.05								>0.05

RF radial forearm, *ALT* anterolateral thigh, *Dif.* difficult

difficult activity; 1 patient referred difficult saliva and swallowing; 1 patient referred difficult speech and social function.

In VSS (Table 3), the mean scores between the groups differed significantly. Scars that formed in the RF group patients were less elastic with greater changes in pigmentation, mainly in the donor site. In the reconstructed site, significant differences were seen in pigmentation and flexibility ($p < 0.05$). However, ALT had a more bulky appearance at first than RT. The differences between the two groups in pigmentation, flexibility, height, and vascularity were significant in the donor site ($p < 0.05$).

Long-term measurable quantitative changes in function of the donor site had the following results. In the RF group, pronation at the wrist and manual dexterity were found to be reduced in the donor side compared with the nondonor side in two patients (13.3 %). The operated side demonstrated decreased hand dexterity, with no change in wrist and forearm ROM in three patients (20 %). One patient also reported cold intolerance.

Hence, manual dexterity was slower on the operated donor side than on the nonoperated side in a total of five patients (33.3 %) in the RF group. However, despite this objective measurement of difference in dexterity, only one patient reported a difference in their ability to perform tasks adequately at work, in the household, or outdoors.

In the other nine RF patients, there were no changes in articular function of the donor site compared with the contralateral nondonor site. The functionality of the knee of ALT patients was the same in the donor site and nondonor, both in flexion and extension.

DISCUSSION

RMT squamous cell carcinoma is uncommon but notorious for poor prognosis, and the treatment of patients with locally advanced RMT tumours is challenging.[1,2] Because of advancements in microsurgical techniques, more extensive resections are now possible. The goal of reconstruction is to maximize oral functions and aesthetics with less morbidity, preserving speech, swallowing, and other functions, and reducing donor site morbidity. The current theories about oral reconstruction advocate microsurgery as standard treatment for restoring oral functions in both young and elderly patients. Free flaps, particularly the RF and the ALT, have become the mainstays of oral cavity soft-tissue reconstruction for larger defects.[7–11]

For years, the free RF flap has been the first choice to restore soft-tissue ablation in the oral cavity, despite the sacrifice of an important artery of the hand.[12,13] In the past years, the ALT flap has challenged the superiority of RF

TABLE 3 Scar evaluation according to the Vancouver scale

Group	Score	Reconstructed site								Donor site							
		Pigmentation		Flexibility		Height		Vascularity		Pigmentation		Flexibility		Height		Vascularity	
		RF	ALT	RF	ALT	RF	ALT	RF	ALT	RF	ALT	RF	ALT	RF	ALT	RF	ALT
	0	0	0	1	1	14	13	12	13	0	7	0	7	6	7	4	7
	1	10	5	8	9	1	2	3	2	6	4	2	7	9	6	5	7
	2	5	9	6	5	0	0	0	0	3	2	8	1	0	2	5	1
	3	0	1	0	0	0	0	0	0	6	2	4	0	0	0	1	0
	4	–	–	0	0	–	–	–	–	–	–	1	0	–	–	–	–
	5	–	–	0	0	–	–	–	–	–	–	0	0	–	–	–	–
p value		<0.0001				0.5		0.567		<0.0001						0.027	

RF radial forearm, *ALT* anterolateral thigh

flap. ALT flap can be thinned, does not need a skin graft, and does not risk damage to tendons or hands.[14–16]

The free RF flap was developed in China in 1978 and was first described in Yang's 1981 article. It is commonly used for tongue, floor of mouth, lip, and hard palate reconstruction. Its greatest advantage is the thin and pliable nature of the flap, ideal for intraoral soft-tissue lining defects. Its ease of harvest and long pedicle (up to 20 cm) with large calibre vessels makes it popular with beginners. The entire skin in the volar aspect of the forearm can be harvested with the long pedicle. Other advantages are the presence of large diameter superficial veins (cephalic or basilic) and deep venous system (the venae comitantes). It also can be harvested with two skin paddles, and if necessary the palmaris longus tendon can be harvested to sling the flap to aid in oral competence during lower lip reconstruction. It can be harvested with radial bone for bone defect.

The major disadvantage of RF is donor site morbidity, especially in cases of paratenon damage during flap harvest causing tenting and painful donor site. Other disadvantages are the need to sacrifice a major artery in the upper limb, decreased sensation in the region supplied by antebrachial cutaneous nerve, and large donor site scar.[17–19]

ALT, an extremely versatile flap, introduced by Song et al. in 1984, is supplied by the descending branch of the lateral circumflex femoral artery. It enjoys many advantages, including low donor site morbidity, simultaneous harvest, large volume of skin and soft tissue available, a long pedicle, acceptability of site for the scar, ability to harvest as subcutaneous, fasciocutaneous, musculocutaneous, or adipofascial flap, thus giving multiple applications for this flap. Some authors infer that the variability in vascular anatomy is the reason why the ALT was less favoured during the early 1990s, but this is not the case; ALT is now viewed as the flap of choice in large soft-tissue defects of the oral and maxillofacial region in many centres. Thus, not the variability in anatomy, but the unfamiliarity of surgeons in harvesting the flap, is the reason that ALT was not favoured initially. This flap had the advantage of the possibility of primary closure of donor site and minimal donor site morbidity. Disadvantages of ALT include (1) lack of bone stock, because this is a pure soft-tissue flap, (2) difficult intramuscular dissection is necessary, because it is a perforator flap, and (3) risk of morbidity when wider flaps are harvested with skin grafting and when vastus lateralis is harvested along with the flap.[17,20,21]

The RF along with the ALT can be considered the workhorses for reconstructing upper aerodigestive tract defects.[22–25] To assess differences between RF and ALT, this investigation compares functional outcomes after RMT cancer resection and microvascular reconstruction. We observed overall better morphofunctional outcomes for ALT flap. Minor donor site morbidity for ALT flap was observed both the short- and long-term follow-up. We also observed better results regarding the scarring.

Functional results are difficult to assess in the oral cancer population. Factors, such as surgical resection and adjuvant radiotherapy, are fundamental to predict post-treatment functional outcomes. Data obtained in the present study indicate that sensation, swallowing capacity, and social function are better when an ALT is used. No significant differences were seen for other functions between RF and ALT. From a statistical point of view, the differences between the two groups were significant ($p < 0.05$) for donor site complications, cosmetic appearance, and scar evaluations.

Our sample of patients was normal-weight at the time of tumour diagnosis; nevertheless, patient's BMI is a critical fact when deciding between the RF and ALT flap. The use of the ALT flap can be limited by patient body habitus, whereas the RF flap can be used for oral reconstructions because of its thin nature. In this regard, some authors state

that if the thickness of the subcutaneous fat at the site of the perforator exceeded 1.5 cm, the patient should be excluded from the studies.[26] On the other hand, other authors do not believe the excess fat tissue is a problem because the flap can be thinned. A thinned ALT flap often is necessary to achieve optimal reconstruction. A recent review describes the techniques available for immediate flap thinning and the vascular complications that can follow trimming.[27] This systematic literature review conclude that the subfascial dissection of ALT flaps revealed that the safest method for minimizing vascular complications accounted for a 3.1 % probability for marginal necrosis, which can be managed conservatively. The overall breakdown of the vascular-related complications that followed flap thinning totals 13.4 % and can be broken down as follows: partial flap loss of 4.1 %, partial distal necrosis of 3.5 %, marginal necrosis of 3.1 %, and total flap loss of 2.5 %.[27]

The RF free flap can result in measurable quantitative changes in hand function and limited changes in patient perception.[28] In this study, manual dexterity was slower on the operated donor side than on the nonoperated side in a total of 5 patients (33.3 %) in the RF group. Without preoperative data, the nondonor arm is very useful.

Due to the donor arm also being the nondominant arm, it is expected that a portion of the time difference in dexterity will be due to the use of the dominant hand versus the nondominant hand. Preoperative donor hand dexterity testing to compare to postoperative donor hand dexterity was not completed and is a limitation of this study.

There are several established variations on the forearm flap. Prelaminated fasciocutaneous flaps can reduce donor site morbidity of wrist extension, hand strength and sensation, and improved cosmesis.[29]

The forearm flap remains a reliable and versatile option in head and neck reconstruction. However, objective and subjective concerns regarding the donor site postoperatively must be considered prior to surgery.[28,29] This study has shown that objective testing of the ROM at donor site can demonstrate donor site morbidity at long-term follow-up in the RF group and not in the ALT group, although overall patients are functionally satisfied and tolerate the donor site postoperatively.

Overall, we verified better results for patient reconstructed with ALT flap compared with those patients reconstructed with RF flap, which should be considered for future surgical planning. However ALT microsurgical reconstructions are not without potential morbidities, require specialized surgical skills, and often are lengthy procedures.

RF RMT reconstructions were superior in case of small defects. This is probably because ALT flap thinning around perforator usually stops in a range of 3 cm from the point of perforator penetration in the flap. In these cases, RF could be plied and sutured in a 3D fashion following the anatomy of the region without altering it.

The reconstruction oral cavity defects represent a challenge because of the critical role of this area both aesthetically and functionally. An orientated approach may be helpful to decide which type of flap should be used for reconstruction of the head and neck. To establish the optimal treatment protocol for patients undergoing major RMT resection, further prospective studies involving greater numbers of patients are necessary.

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