ORIGINAL ARTICLE

Mandibular reconstruction after resection of benign tumours using non-vascularised methods in a series of patients that did not undergo radiotherapy

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Abstract

Aim: A case series analysis of 52 consequent subjects of immediate mandibular reconstruction after tumour resection using non-vascularised methods, undertaken at U.P. King George's University of Dental Sciences and King George's Medical University, is being reported. To assess the success of reconstruction on subjective and objective evaluation based upon Mandibular Reconstruction Assessment Scale (MRAS) questionnaire.

Methods: Patients with benign mandibular tumours irrespective of age, sex, site and socio-economic status were included. Primary reconstruction was carried out after resection in two surgical units on surgeon's choice using stainless steel wire (6/52; 12%), stainless steel reconstruction plate (10/52; 19%) or titanium reconstruction plate (36/52; 69%) without bone graft (23/52; 44%) or with bone graft (29/52; 56%). Bone grafts were harvested from iliac crest (21/52; 40%), rib (2/52; 4%) and an additional pectoralis major myocutaneous flap with iliac crest bone graft (6/52; 12%) to provide cover to the reconstruction plate was also used.

Results: The primary outcome measurements were wound healing, mouth opening, chewing efficiency, jaw movements, cosmetic achievement and speech on a five-point scale, all of which improved significantly after surgery. The overall complication rate was 17%. Three patients (6%) had loosening of the screw, two (4%) showed dehiscence of the plate, two (4%) showed tumour recurrence and one (2%) had infection of the graft that was subsequently removed.

Conclusion: Titanium reconstruction plates with iliac crest graft provided good result in the absence of microvascular reconstruction because of unavailable long operating time and lack of expertise. Long-term satisfactory rehabilitation can be achieved using removable dentures or prosthesis on dental implants on the contraption provided by the non-vascularised tissue despite non-calcified bone visible on the skiagram.

Introduction

Reconstruction of hard and soft tissue defects of mandible created by ablative tumour surgery require specific, three-dimensional facial proportions to produce proper function and cosmetic outcomes with least complications at an affordable cost and available resources. Restoration of mandibular function in speech, mastication and deglutition is essential to prevent any undesirable outcome and debilitating condition. Primary reconstruction prevents the patient from developing oral incompetence, collapse of airway and deformity[1–3].

The goals of reconstruction are achievement of primary wound closure, functional improvement of speech, deglutition, aesthetic preservation and prosthetic rehabilitation, thus improving the quality of life[4].

Although many surgical techniques have evolved over the years, the search for the most appropriate technique in each situation is the focus of ongoing research. Several methods of reconstruction of the mandible are available, including free or vascularised autologous bone grafts with reconstruction plates[5]. Microvascular surgery and the vascularised osteocutaneous flap is the preferred surgical technique for reconstruction as the maintained blood flow provides relative resistance to infection and resorption. However, such procedures require well-trained microvascular surgeons, long operating hours and general anaesthesia, longer hospital stay and a high cost. Tumour prognosis and available resources can be reasons to choose for simpler procedures. Poor general health, advanced cancer, poor patients deprived of resources and microsurgical facilities can be taken up for reconstruction with a plate of stainless steel or titanium as an easier option[6,7]. However, problems such as loosened screw, plate fracture, fistula, plate exposure and infection can be associated with the use of plates[8]. Additionally, a non-vascularised free bone graft from rib or iliac crest can be used along with the reconstruction plate.

The type of defects created after mandibular tumour excision are described as follows (HCL classification)[8,9]:
H: haemimandibulectomy defects containing condyle
C: central defects consist of entire central segment including both incisors and canines
L: lateral defects that do not cross the midline and do not include the condyle
LCL, HC: Large combined defects.

A case series of 52 subjects undergoing mandibular reconstruction using wire or plate fixation with or without non-vascularised bone graft from rib or iliac crest was undertaken and assessed for success of reconstruction on subjective and objective evaluation based upon Mandibular Reconstruction Assessment Scale questionnaire (MRAS).

Material and methods

All patients with benign mandibular tumours, who visited the Department of Oral and Maxillofacial Surgery, and Department of Surgery, CSMMU (formerly King George's Medical University), irrespective of age, sex, site, caste, religion and socio-economic status between 1994 and 2004, who underwent mandibular resection were offered reconstruction using non-vascularised methods. Of the 64 consecutive patients during the period of study, 52 patients underwent one or another mode of mandibular reconstruction. None of these patients underwent radiotherapy post-operatively. Twelve patients dropped out on account of poor resource crunch. These patients simply had soft tissue repair and were in regular follow-up without mandibular reconstruction.

The surgical technique involved curvilinear submandibular incisions to resect the tumour in majority. Lip splitting was done in patients with bulky tumours, where condylar head was also removed along with the tumour. Primary reconstruction was done with transosseous wiring or reconstruction plates (Figs. 1 and 2) with or without bone graft. Either a cortico-cancellous bone graft (Fig. 3) was harvested from the lateral aspect of anterior iliac crest or a subperiosteal rib graft was harvested when a longer graft was required, by a

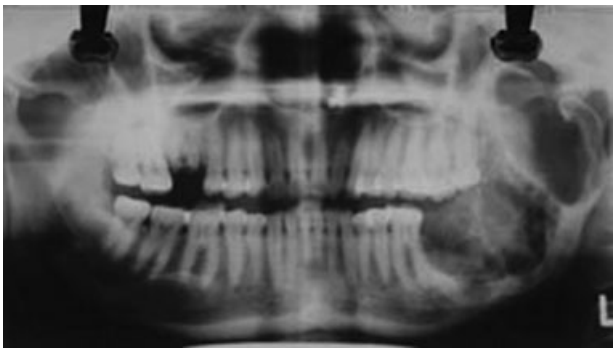

Figure 1 Preoperative orthopantomogram of a patient showing the extent of the lesion, 105 × 59 mm (72 × 72 DPI).

Figure 2 Post-operative X-ray mandible of the same patient showing the reconstruction done using reconstruction plate with condylar head, 105 × 79 mm (72 × 72 DPI).

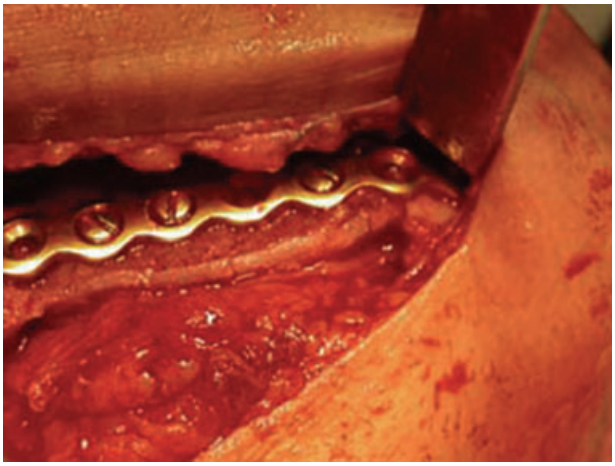

Figure 3 Intra-operative photograph of another patient showing iliac crest graft fixed with reconstruction plate, 105 × 79 mm (72 × 72 DPI).

second team of surgeons simultaneous to mandibular resection surgery. Such a non-vascularised bone graft was supplemented only in cases where there was no soft tissue shortage of oral mucosa and a good water-tight intra-oral closure without tension could be achieved. The bone graft was used to reconstruct the defect up to the angle region to provide a denture bearing area. Stainless steel or titanium reconstruction plates (TRPs) was used to fix the grafts and provide an aesthetic facial contour. These plates were adapted preoperatively on mandibular models. Oversize plates and bone grafts were avoided. An *in situ* muscle wrap on the bone from three sides was achieved in all the cases. The soft tissue cover and mucosal closure was achieved tension free. Pectoralis major pedicled muscle flap without skin was used in patients with soft tissue defects to provide a cover for the reconstruction plate. All the patients were rehabilitated 3–6 months post-operatively either with removable dentures or with dental implants (Fig. 4) and have been in regular monthly follow-up. The follow-up period ranged from 4 years to 12 years with a median follow-up of 5.2 years (Figs. 5 and 6).

Assessment of outcome was longitudinal–pretreatment, early (from 10th post-operative day to 4 weeks) and late (after 6 months). The main study variables were type of tumour and defect, management done and fixation method used. A MRAS was prepared after discussion with peers and focus group, which consisted of five close-ended response questions on a five-point Likert scale. This questionnaire was peer reviewed and evaluated for test–retest reliability. It included all the basic criteria which govern the success of the procedure and described the status of the patient

Figure 4 Three months post-operative X-ray mandible postero-anterior view of the same patient showing iliac crest graft fixed with reconstruction plate and placement of three dental implants on the grafted bone, 25 × 33 mm (300 × 300 DPI).

Figure 5 Preoperative front view photograph of a patient with amoeloblastoma left mandible, 79 × 59 mm (96 × 96 DPI).

for which the whole treatment was planned. The MRAS instrument was completed by the patient as well as the operating surgeon or his team; the mean of these values was used for the evaluation of outcome. The MRAS questionnaire was administered for six items, *viz*., wound healing, mouth opening, chewing, pain in jaw movements, aesthetics and speech. Higher scores yielded better result. This questionnaire was completed

Figure 6 Post-operative front view photograph of the same patient after resection and reconstruction using titanium reconstruction plate and no bone graft, 25 × 33 mm (300 × 300 DPI).

initially at the time of first examination, at early post-operative phase and later after 6 months post-surgery.

The outcome was also assessed by occurrence of any complication like gape, discharge, loosening of screws, plate dehiscence, donor site infection, rejection of graft and gait disturbances. Criteria for success were re-construction that did not require removal of plate or graft and successful fabrication of either a removable denture or a prosthesis over dental implants. Dental implants could not be placed in most patients because of the cost factor. A non-parametric Mann–Whitney U-test was used to assess the difference between the three groups – stainless steel wire (SSW), stainless steel reconstruction plate (SRP) and TRP.

Results

Table 1 provides the demographic data, diagnosis, type of defect, method of reconstruction and use of bone graft. Patients' age ranged from 13 years to 61 years (mean 31.7 years), 32 were males and 20 were females. The patients were followed for a minimum of 6 months. Only benign tumours of mandible have been included in this series, of which majority had amoelo-blastoma, 66%. HCL classification showed L defect to be the most common (53%).

Table 1 Demographic, diagnosis, type of defect and management distribution

	SSW ($n = 6$) (12%)	SRP ($n = 10$) (19%)	TRP ($n = 36$) (69%)	No. 52	%
Age group					
<20 years	0	4	4	8	15
20–50 years	4	5	31	40	77
>50 years	2	1	1	4	8
Sex					
Male	3	6	23	32	62
Female	3	4	13	20	38
Diagnosis					
Amoeloblastoma	2	6	27	35	66
Amoeloblastic fibroma	–	–	1	1	2
Odontogenic myxoma	1	1	2	4	8
Ossifying fibroma	2	–	3	5	10
Odontogenic keratocyst	–	2	–	2	4
Osteoclastoma	1	1	2	4	8
Odontome	–	–	1	1	2
Type of defects					
H	2	1	6	9	17
L	3	5	20	28	53
C	1	2	3	6	12
CL	–	2	2	4	8
LCH	–	–	1	1	2
CH	–	–	4	4	8
Type of graft					
No graft	–	5	18	23	44
Graft ($n = 29$)					
Iliac crest only	5	3	13	21	40
Rib	1	–	1	2	4
Iliac crest + Pectoralis major Myocutaneous flap	–	2	4	6	12
Total	6	10	36	52	

C, central defects consist of entire central segment including both incisors and canines; H, haemimandibulectomy defects containing condyle; L, lateral defects that do not cross the midline and do not include the condyle; LCL, HC, large combined defects; SRP, stainless steel reconstruction plate; SSW, stainless steel wire; TRP, titanium reconstruction plate.

The method of reconstruction used was based on surgeon's choice, patient's affordability and availability of resources (operating time and material) at the time of surgery. Reconstruction with SSW was done in six patients (12%), SRP in 10 patients (19%) and TRP in 36 patients (69%). Cortico-cancellous iliac crest graft was given in 27 patients (52%) where there was no soft tissue shortage of oral mucosa and a good watertight intra-oral closure without tension could be achieved. Either dental implants were fixed on the grafted bone for oral rehabilitation after 3 months or the patients were provided with removable dentures. The maximum reconstruction consisted of condylar head of

Table 2A Mandibular Reconstruction Assessment Scale versus type of fixation (mean values)

Type	Wound healing	Mouth opening	Chewing efficiency	Pain in jaw movements	Aesthetics	Speech
Preoperative		1.52 ± 0.42	1.18 ± 0.81	1.86 ± 0.39	1.20 ± 1.40	1.50 ± 0.80
SSW, $n = 6$	2.50 ± 0.55	2.33 ± 0.52	1.33 ± 1.03	2.33 ± 0.81	1.67 ± 0.52	3.33 ± 0.52
SRP, $n = 10$	3.00 ± 0.82	3.20 ± 0.63	1.50 ± 1.17	2.80 ± 0.63	3.10 ± 0.74	3.70 ± 0.67
TRP, $n = 36$	3.67 ± 0.89	4.14 ± 0.80	1.67 ± 0.79	3.94 ± 0.83	4.25 ± 0.77	4.22 ± 0.72
P (Kruskall–Wallis test)	0.006	<0.001	0.760	<0.001	<0.001	0.009

Table 2B Mandibular Reconstruction Assessment Scale versus type of fixation: intergroup comparison

Variable	SSW versus SRP		SSW versus TRP		SRP versus TRP	
	Z	*P*	*Z*	*P*	*Z*	*P*
Wound healing	1.128	0.263	2.829	0.005	1.963	0.064
Mouth opening	2.365	0.031	3.720	<0.001	2.997	0.003
Chewing efficiency	0.707	0.792	0.587	0.636	0.977	0.990
Pain in jaw movements	1.095	0.368	3.351	<0.001	3.471	0.001
Aesthetics	2.953	0.003	4.069	<0.001	3.428	0.001
Speech	1.095	0.368	2.619	0.012	1.981	0.068

SRP, stainless steel reconstruction plate; SSW, stainless steel wire; TRP, titanium reconstruction plate.

one side to contralateral angle. The length of the harvested graft ranged from 4 cm to 18 cm with a height of at least 1.5 cm. To reconstruct a defect of 18 cm, 9 cm long and 3 cm height graft was harvested with a thickness of 8 mm, which was split into two halves heightwise to achieve the required length.

The patients had at least two sittings of evaluation post-operatively, one from 10 days to 4 weeks (early) and another 6 months after (late). SRP was found to be superior to SSW in terms of mouth opening and aesthetics. However, no significant difference was observed between SSW and SRP for variables like wound healing, jaw movements and speech when simple wiring was used. TRP was universally better in all the outcome variables when compared with SSW and SRP, and a non-parametric statistical test was used. The test statistics and statistical significance are also shown in Table 2A,B.

Based on the MRAS score, evaluation of reconstruction was done by the operating surgeon or his team and the patient. Mouth opening, jaw movements and aesthetics results were significantly better with the use of non-vascularised bone graft along with plate fixation. Iliac crest bone graft, used in 27 patients, provided significantly better results. When bone graft group was compared with additional flap group, even better results were observed. The rib graft was placed in only two patients; this group could not be compared because of its small sample size (Table 3A,B).

Criteria for success were reconstruction that did not require removal of plate or graft and placement of either removable partial dentures or a prosthesis over dental implants, producing a success rate of 83% (Table 4).

Overall global assessment of complications performed post-operatively at 1 month was 24/52 (46%). The main complication observed was transient gait disturbances (15/52, 29%) on account of donor site iliac crest surgery. Localised infection and discharge with skin gape at recipient site were seen in 4/52 (8%) that subsided later with antibiotics and local dressings in all but one patient where the graft was infected and had to be removed. Intra-oral gaping of the wound was observed in 2/52 (4%) patients that healed normal with resuture. None of the patients had plate fracture or dehiscence. Pain in temporomandibular joint region was seen in 2/52 (4%), which improved with function in a month (Table 5).

Late complication rate observed at 6 months recall visit was 9/52 (17%). Loosening of the screw was the most common 3/52 (6%), with plate dehiscence 2/52 (4%); recurrence of tumour in the coronoid and condylar region was in 2/52 (4%) patients with lateral defect and had to be managed by second surgery with removal of even the condyle and coronoid, and reconstruction was then done with reconstruction plate with condylar prosthesis (Table 5).

Average post-operative hospital stay was 5 days; none of the patient was allowed to smoke in the hospital and was actively encouraged to quit tobacco. Patients were taken up for full mouth oral rehabilitation 3 months to 2 years after surgery.

Table 3A Mandibular Reconstruction Assessment Scale versus type of graft (post-operative mean values)

Type	Wound healing	Mouth opening	Chewing efficiency	Pain in jaw movements	Aesthetics	Speech
Preoperative		1.52 ± 0.42	1.18 ± 0.81	1.86 ± 0.39	1.20 ± 1.40	1.50 ± 0.80
No graft (*n* = 17)	4.35 ± 0.49	3.64 ± 0.60	2.12 ± 0.70	3.65 ± 0.70	3.18 ± 0.81	3.35 ± 0.79
Iliac crest (*n* = 27)	3.70 ± 0.72	3.37 ± 0.84	2.26 ± 0.53	4.15 ± 0.72	2.85 ± 0.66	3.44 ± 0.75
Rib (*n* = 2)	2.50 ± 0.70	3.50 ± 0.71	2.00 ± 0.00	3.50 ± 0.71	2.50 ± 0.71	3.00 ± 0.00
Myocutaneous flap (*n* = 6)	3.00 ± 0.632	3.17 ± 0.41	2.17 ± 0.75	3.17 ± 0.41	2.50 ± 0.55	3.33 ± 0.52
P (Kruskall–Wallis test)	<0.001	0.36	0.87	<0.011	<0.001	0.80

Table 3B Mandibular Reconstruction Assessment Scale versus type of graft: intergroup comparison

Variable	No graft versus iliac crest		No graft versus myocutaneous flap		Iliac crest versus myocutaneous flap	
	Z	*P*	*Z*	*P*	*Z*	*P*
Wound healing	2.966	0.003	3.483	<0.001	2.015	0.064
Mouth opening	1.326	0.185	1.747	0.135	0.550	0.633
Chewing efficiency	0.643	0.520	0.878	0.919	0.804	0.838
Pain in jaw movements	2.177	0.029	1.548	0.177	2.842	0.006
Aesthetics	3.966	<0.001	2.023	0.062	1.174	0.302
Speech	0.354	0.723	0.077	0.938	0.362	0.768

Table 4 Successful reconstruction

Type of fixation	Graft uptake	Prosthesis possible
SSW with graft (*n* = 6)	4	Removable denture = 2, dental implants = 0
SRP with graft (*n* = 5)	4	Removable denture = 4, dental implants = 0
TRP with graft (*n* = 18)	16	Removable denture = 14, dental implants = 4
Total with graft (*n* = 29)	24 (83%)	24 (83%)

SRP, stainless steel reconstruction plate; SSW, stainless steel wire; TRP, titanium reconstruction plate.

Table 5 Complications

Type of complication	Early (1–4 weeks)		Late (after 1 month)	
	No. of patients	%	No. of patients	%
Discharge	3	6	1	2
Skin gape	1	2	–	–
Intraoral gape	2	4	–	–
Loosening of screw	–	–	3	6
Removal of graft	–	–	1	2
Plate fracture	–	–	–	–
Plate dehiscence	–	–	2	4
Donor site infection	1	2	–	–
Gait disturbance	15	29	–	–
Tumour recurrence	–	–	2	4
Pain in TMJ	2	4	–	–
Total	24	46	9	17

TMJ, temporomandibular joint.

Discussion

Success of reconstruction depends upon many factors including successful removal of all diseased tissue, proper selection of reconstruction method, healthy host tissue and sound surgical technique. The advances made in head and neck reconstruction over the past 20–30 years have revolutionised the management of both malignant disease and facial deformity. The advantages of primary soft and hard tissue reconstruction include restoration of oral function and maintenance of mandibular continuity. Furthermore, there are improved cosmetic results that provide psychological advantages in terms of patient's self-esteem.

In 1953, vitallium plates were used to fix free bone grafts for mandibular reconstruction[10]. Spiessl (1976) was the first to use metal plates to bridge mandibular defects after tumour resection[11]. Reconstruction plates have been previously used for rigid fixation of vascularised bone grafts, comminuted mandibular fractures and reconstruction of minor defects. Many authors[8,9] still consider use of reconstruction plates for elderly patients or for palliative care where additional bone repair may not be practical initially. Microvascular bone grafts have met reconstructive goals in mainly large defects, though special skills, increased operating time, donor site morbidity and complications have brought some limitations[12]. However, review of literature shows comparison of vascularised and non-vascularised grafts side by side, where non-vascularised grafts for mandibular reconstruction with cancellous cellular bone

grafts were far superior to the vascularised grafts in terms of support of facial form, ability to reconstruct arch form and alveolar bone height of the mandible, and avoid donor site morbidity[13]. Shockley[14], using a pectoralis major flap in 8/18 patients and primary closure in 10/18 reported a success rate of 79%. Simon[15] reported 7/11 cases of amoeloblastoma that had undergone ablative surgery followed by mandibular reconstruction in a single operative procedure using autologous particulate bone from iliac crest, and evaluated them with a quality of life assessment tool adapted from European Organization for Research and Treatment of Cancer (EORTC) head and neck cancer module EORTC Core quality of life questionnaire (C-30).

Minnen *et al.*[1] evaluated the outcome in 36 patients of mandibular reconstruction with SRP, where patients and surgeon gave their opinion on post-operative function and aesthetic results. They observed 71% patients to be totally or partially rehabilitated, while 17 cases showed failed reconstruction because of: plate exposure (seven), fistula (six), loose screws (two), breakage (one) and infection (one). In our series, the incidence of plate fracture was 0%, plate dehiscence was 4% and screw loosening was 6%. Klotch *et al.*[16] observed 8.3% incidence of plate fracture for original SRP, which decreased with the use of advanced designed Titanium hollow screw reconstruction plate (THORP) plates.

Major defects caused by Boyd *et al.*'s[9] HCL defects have the highest rate of complication (up to 87.5%). Highest rate of screw loosening has been observed[17] when reconstruction plates were placed across areas with muscle stress concentration like chin and angle region. In our study, the overall complication rate was 17%, and none of our patient needed removal of reconstruction plate, while one patient (2%) needed removal of graft for control of infection. Lopez *et al.*[18] observed 79% patients to tolerate the plate and reported satisfactory functional and aesthetic results with use of titanium dynamic bridging plates for mandibular reconstruction. Arden *et al.*[19] reported 81% complication rate in defects longer than 5 cm and found that the larger the removed tissue mass is, the more likely the complications occur. The greatest causes for complications are size and location of the defects, masticatory loads on plates contributing to vertical discrepancies and bone resorption around the screw, and screw loosening[20]. Loss of mandibular reconstruction plates in non-irradiated patients after benign tumour resection is less frequent than in the irradiated patients[21]. Okura *et al.*[22] found plate survival with no complications in 62.2% at 5 years and reported use of bridging plates as an option for mandibular reconstruction with no preoperative irradiation. As we limited this series to benign disease and to patients who did not receive radiotherapy, we do not have experience of non-vascularised bone grafts with reconstruction plates in irradiated patients, although there is increased risk of failure in these cases because of lack of vascularity. In our series, criteria for success were reconstruction that did not require removal of plate or graft and placement of removable denture or a fixed prosthesis on dental implants, giving us a success rate of 83%.

Microvascular reconstruction, though, may be considered as the gold standard for partial or total mandibular defects; non-vascularised reconstruction techniques may be more prudent and readily used in majority of situations especially in resource-deficient countries. Based on our study, we can suggest that mandibular reconstruction plates can be effective for reconstruction of mandible if used with non-vascularised bone graft with the following important precautions, all of which were adapted in this series:

1. watertight intra-oral closure using mattress sutures before placement and fixation of the reconstruction plate
2. pre-adaptation of reconstruction plate using an orthopantomogram for the ramus angle region and a mandibular model for the symphyseal region
3. fixation of reconstruction plate with at least three screws on each side
4. precise placement of condylar head in the glenoid fossa before fixing the plate
5. suturing the muscles like masseter and platysma to the plate laterally and medial pterygoid, geniohyoid and genioglossus medially, thus covering the full extent of the plate with these muscles to prevent dehiscence of the plate
6. TRP should be preferred over a stainless steel plate, as superiority of titanium over stainless steel has been proved worldwide without doubt
7. iliac crest graft should readily be used especially in patients where recurrence of the lesion is not suspected
8. a pedicled muscle flap like pectoralis major should be used in adjunction with the graft and reconstruction plate in cases where the soft tissue cover over the plate is thin, thereby minimising the risk of dehiscence of plate.

Conclusion

This case report analysis is aimed to legitimise the option of using SSW and reconstruction plates in a resource-deficient area for benign mandibular reconstruction as a contemporary and competing operation methodology in the surgeons' armamentarium.

MRAS for subjective and objective assessment of mandibular reconstruction by the surgeon or his team

and the patient has served as very good tool for evaluation of outcomes. TRPs with non-vascularised bone grafts are a good alternative to microvascular flaps as they provide comparable or even better outcomes in resource deficit circumstances. Long-term oral rehabilitation can be achieved using removable partial or complete dentures, or fixed prosthesis on dental implants over the contraption provided by the non-vascularised tissue despite non-calcified bone visible in the radiograph.

Facility for microvascular surgery is unlikely to become available in the near future in this department. Hence, a randomised controlled trial to compare the vascularised and non-vascularised free bone graft is difficult to conduct in the present scenario. A cross-sectional study by case series analysis with subjective and objective assessment of outcomes therefore should suffice. Ideal trial design study should be a comparison of SRP and TRP, both rigid fixation systems. Such a study would require random allocation, *a priori* sample size calculation, long-term assessment and mechanical assessment, which were not undertaken in this study.

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Appendix

Mandibular Reconstruction Assessment Scale (MRAS)

I Evaluation of Wound Healing

The wound created after resection of jaw healed

1 with rejection of the graft
2 with pus discharge and needed local curettage and antibiotics
3 with watery discharge and was managed by some antibiotic coverage
4 with primary healing
5 without any obvious scar

II Evaluation of Mouth Opening

I am able to open my mouth

1 <1 cm
2 2 cm
3 3 cm
4 4 cm
5 >4 cm

III Evaluation of Chewing Efficiency

I am able to eat food

1 denture not possible
2 only liquids
3 only soft food (porridge)
4 chew some food (chapatti)
5 can even bite and chew an apple

IV Pain in Jaw Movements

My jaw movements are

1 extremely painful
2 moderately painful
3 mild pain present
4 no pain, but deviation on opening
5 smooth pain-free movements possible in all directions

V Evaluation of Esthetics

My looks are acceptable in the society as

1 poor (exposure of plate/graft)
2 unsatisfactory (residual facial disfigurement/asymmetry)
3 satisfactory (facial symmetry achieved)
4 good (restoration of facial form and contour)
5 perfect (with good alveolar height for denture placement)

V Evaluation of Speech

1 I am not able to speak
2 I can not pronounce most words clearly
3 I can not pronounce some words clearly
4 My speech is clear
5 My speech is perfect