

Comparison of lip function: surgery vs radiotherapy

M. F. STRANC, M. FOGEL and S. DISCHE

Department of Plastic Surgery, University of Manitoba, and Marie Curie Research Wing for Oncology, Mount Vernon Hospital, Middlesex

Summary—This work was undertaken to compare lip function after surgery and after radiotherapy. In all, 37 patients were studied, 19 post-surgery and 18 after radiotherapy. Both physical lip parameters, such as intercommissural distance and soft tissue gape, as well as sensation and functional outcome, were assessed.

The cure rates were found to be comparable in both groups. Our study shows functional benefits when radiotherapy is used as opposed to extensive surgery. This is due primarily to the loss of sensation and elasticity which follows surgery.

Over the past several decades, the choice of surgery or radiotherapy for treatment of lip neoplasms was influenced by a number of factors. Of these, the most important were: general condition of the patient, tumour type and size, presence or absence of nodal disease, cure rate, economic considerations and appearance of the lip following treatment. Recent literature supports the view that either modality has comparable cure rates (Jorgensen *et al.*, 1973; Hendricks *et al.*, 1977; Hornback and Shidnia, 1978; Heller and Shah, 1979; Petrovich *et al.*, 1979; Baker and Krause, 1980; Fitzpatrick 1984). It is commonly accepted that old or infirm patients and those with large tumours (larger than 4 cm) are better treated with radiotherapy or a combination of both modalities (Jorgensen *et al.*, 1973; Hornback and Shidnia, 1978; Heller and Shah, 1979; Petrovich *et al.*, 1979; Baker and Krause, 1980; Fitzpatrick, 1984). When all these factors are considered, the choice of therapy is often ultimately determined by the comparative strengths of the surgery or radiotherapy department available (Hornback and Shidnia, 1978; Marshall and Bennett, 1982; Fitzpatrick, 1984).

In the past, any discussion of the functional outcome of therapy focused primarily on the appearance and sphincteric action of the treated lip. Until recently, observations in both the pre- and the postoperative phases were always subjective since the methodology necessary to record unbiased, objective data had not yet been developed.

The purpose of this work is to evaluate objectively, using techniques developed by Stranc, Fogel and Page (Page and Stranc, 1982; Fogel and Stranc,

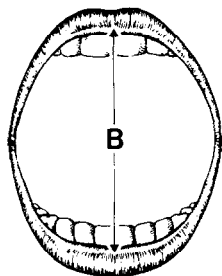
1984; Stranc and Fogel, 1984), two groups of patients with cancers of the lip. One group was treated using radiotherapy and the other by surgery. It is hoped that the comparison of functional outcome will allow a more objective approach to the selection of treatment modality.

Materials and methods

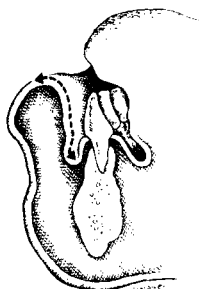
Of the patients studied, 19 were treated surgically and 18 received radiotherapy for tumour control. The patients in the surgical group were either operated on by, or seen in consultation with, the senior author (MFS). Because of a paucity of clinical material the radiotherapy group was developed in conjunction with SD at the Marie Curie Research Wing for Oncology at the Mount Vernon Hospital, Middlesex, England. Thirteen patients were examined in Mount Vernon; the remainder of the group was studied in Winnipeg. Examinations in both centres were carried out by the same individual (MF). All patients were asked if they had any drooling, dribbling, difficulty in eating, pain or altered lip sensation. Specific problems with dental care or dentures were also recorded and the quality of speech was noted.

Objective assessment of lip function was based on the following parameters (Fig. 1): intercommissural distance at rest, while pursing, and also during maximum lip retraction (smiling); soft tissue gape; depth of the upper and lower sulci; determination of two point discrimination in the four lip quadrants; and, using a pommeter, the strength of the orbicularis oris muscle (Fogel and Stranc, 1984). Details of therapy that were recorded for each

**SOFT TISSUE
GAPE**



LIP HEIGHT



LIP ELASTICITY

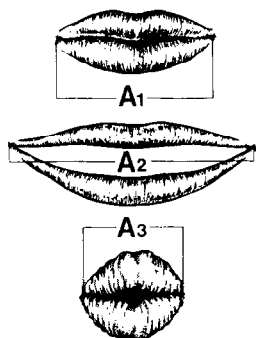


Fig. 1

Figure 1- Measurement of physical characteristics of the lip: soft tissue gape-B, lip height, and intercommissural distance at rest—A1, during maximal lateral lip retraction—A2, and during maximal lip contraction—A3.

group included histological diagnosis, tumour size and site (Table 1), details of surgical and radiotherapeutic treatment (Table 2) and the physical parameters of the lip (Table 3). The interval between treatment and follow-up was recorded in months.

Finally, wedge, Karapandzic and steeple reconstructions were compared (Table 4) to gain a better

Table 1. Tumour diagnosis, site and mean size

	Radiotherapy	Surgery
Number of cases	18	19
Diagnosis		
Squamous cell carcinoma	14	16
Basal cell carcinoma	3	1
Malignant melanoma	0	2
Others	1	0
Site		
Lower lip	12	17
Upper lip	6	2
Mean size (max. diam.)	3.2 cm	3.1 cm

Table 2 Details of treatment

<i>Radiotherapy</i>	
Mean field size	18.4 sq. cm.
Mean rads	4425
Mean days	15.4
Mean number of fractions	11.3
Mean follow-up	68 months
<i>Surgery</i>	
Operative procedures used:	
— 6 wedge resections	
— 1 Johanson step technique with vermilionectomy	
— 5 Karapandzic reconstructions	
— 5 steeple flap reconstructions	
— 1 modified Bernard reconstruction	
— 1 modified Dieffenbach reconstruction	
Mean follow-up	20.4 months

Table 3 Physical parameters of the patient population studied

	Normal*	Radiotherapy	Surgery
<i>Number of Patients</i>			
Males	29	17	19
Females	0	1	0
Total	29	18	19
<i>Age (yrs)</i>			
Mean	64.7	67.8	64.7
Standard deviation	3.4	7.6	11.6
<i>Intercommissural Distance - At Rest (mm)</i>			
Mean	63.8	65.7	64.6
Standard deviation	5.5	7.7	8.8
<i>Intercommissural Distance - Smiling (mm)</i>			
Mean	76.9	79.9	74.9
Standard deviation	6.0	8.2	10.6
<i>Intercommissural Distance - Pursing (mm)</i>			
Mean	46.0	46	51.68
Standard deviation	8.4	7.1	9.3
<i>Gape (mm)</i>			
Mean	46.9	47.6	47.8
Standard deviation	10.4	7.4	8.4
<i>Upper Sulcus (mm)</i>			
Mean	23.5	22	24
Standard deviation	3.6	2.6	3.4
<i>Lower Sulcus (mm)</i>			
Mean	23.1	22	23.2
Standard deviation	4.6	3.7	2.6

* Controls were age-matched males.

[continued overleaf.]

Table 3—continued

	Normal*	Radiotherapy	Surgery
<i>Two Point Discrimination (mm)</i>			
<i>Upper Right Quadrant</i>			
Mean	3.4	3.3	5.2
Standard deviation	1.3	1.4	5.0
<i>Upper Left Quadrant</i>			
Mean	3.3	3.4	5.0
Standard deviation	1.3	1.4	5.0
<i>Lower Right Quadrant</i>			
Mean	3.3	3.3	10.6
Standard deviation	1.3	1.3	8.9
<i>Lower Left Quadrant</i>			
Mean	3.4	3.6	13.6
Standard deviation	1.3	1.2	10.0
<i>Pometer (grams)</i>			
Mean	300.4	297.2	291.6
Standard deviation	107.2	111.0	192.0
<i>Elasticity Index</i>			
Mean	49.1	52.0	36.0
Standard deviation	14.0	11.0	12.6
<i>Oral Aperture (mm)</i>			
Mean	28.5	30.1	28.3
Standard deviation	7.5	6.8	7.0

* Controls were age-matched males.

Table 4 Comparison of wedge, steeple and Karapandzic procedures

	Wedge	Steeple	Karapandzic
<i>Number of Patients</i>	6	5	5
<i>Intercommissural Distance—At Rest (mm)</i>			
Mean	62.0	71.0	64.0
Standard deviation	0.8	0.8	0.9
<i>Intercommissural Distance—Smiling (mm)</i>			
Mean	78.0	60.0	75.0
Standard deviation	1.1	0.5	1.3
<i>Intercommissural Distance—Pursing (mm)</i>			
Mean	48.0	49.0	48.0
Standard deviation	1.0	0.4	0.7
<i>Gape (mm)</i>			
Mean	44.0	26.0	51.0
Standard deviation	1.0	0.3	0.9
<i>Lower Sulcus (mm)</i>			
Mean	23.0	24.0	22.0
Standard deviation	0.7	0.2	0.2
<i>Two Point Discrimination (mm)</i>			
<i>Lower Right Quadrant</i>			
Mean	5.5	8.0	8.5
Standard deviation	1.2	3.1	3.4
<i>Lower Left Quadrant</i>			
Mean	5.7	8.2	5.8
Standard deviation	1.3	2.7	3.0

	Wedge	Steeple	Karapandzic
<i>Upper Right Quadrant</i>			
Mean	3.8	5.8	3.5
Standard deviation	1.6	5.8	3.5
<i>Upper Left Quadrant</i>			
Mean	3.9	5.8	4.0
Standard deviation	1.6	2.8	1.2
<i>Pometer (grams)</i>			
Mean	226.0	496.0	251.0
Standard deviation	124.0	238.0	116.0
<i>Elasticity Index</i>			
Mean	42.0	45.0	41.8
Standard deviation	13.0	8.5	9.4
<i>Oral Aperture (mm)</i>			
Mean	25.8	30.1	30.7
Standard deviation	4.0	3.2	9.8

understanding of the benefits and drawbacks associated with each technique.

Results

Lip parameters in both the radiotherapy, surgical and normal group and between the three surgical procedures were evaluated using a multiple *t*-test with Bonferroni adjustment and adjusting for unequal variance. Since the surgical outcomes were compared both to normal values and to those obtained following radiotherapy, and as the working hypothesis did not specify a clinical bias towards the outcome, a two-tailed hypothesis was specified for the *t*-test.

Significant findings ($p < 0.05$) showed that:

- lower lip sensation, as determined by two point discrimination, was markedly diminished in surgical patients as compared to both normals and radiotherapy. This was not observed in the radiotherapy group when it was compared with the normals.
- intercommissural distance while pursing was decreased in the surgical patients as compared to both the normal and radiotherapy group. No significant difference was found between the latter two groups.
- elasticity of the residual lip curtain was greatly reduced in patients who had undergone surgery as compared to both the normal and radiotherapy group. Again, the difference between the normal and radiotherapy group was not significant.

When the steeple, wedge and Karapandzic procedures were compared statistically, the following findings were observed to be significant ($p < 0.05$):

- the commissural distance at rest was significantly larger in the steeple reconstructions when compared to the Karapandzic and the wedge.
- the Karapandzic flap resulted in a better maintenance of pursing ability when compared to the steeple. The differences between the wedge and steeple and wedge and Karapandzic were not significant.
- the steeple excision resulted in significantly lowered values for the elasticity index when compared to the wedge excision. When the steeple and Karapandzic reconstructions were compared this trend was also seen but just fell short of significance, a reflection of the small sample size.
- the steeple flap resulted in an increased pommeter

value both when compared to the wedge and Karapandzic excisions and also when compared to normal values.

A study of oral continence revealed that only 2 of the 18 patients who received radiotherapy complained of dribbling whereas 8 of the 19 patients treated surgically found difficulty in achieving a satisfactory lip seal.

Difficulty with eating was noted by 3 of the 19 surgical patients and none in the other group. This was due to a lack of sensation in the reconstructed lip, making it difficult to monitor the presence or temperature of food as it entered the mouth. These patients learned to compensate for this disability by using the tongue as a sensory organ. No difficulty with food retention or propulsion was encountered in either group.

Access to the oral cavity was restricted in only one patient from the entire sample. His lip had

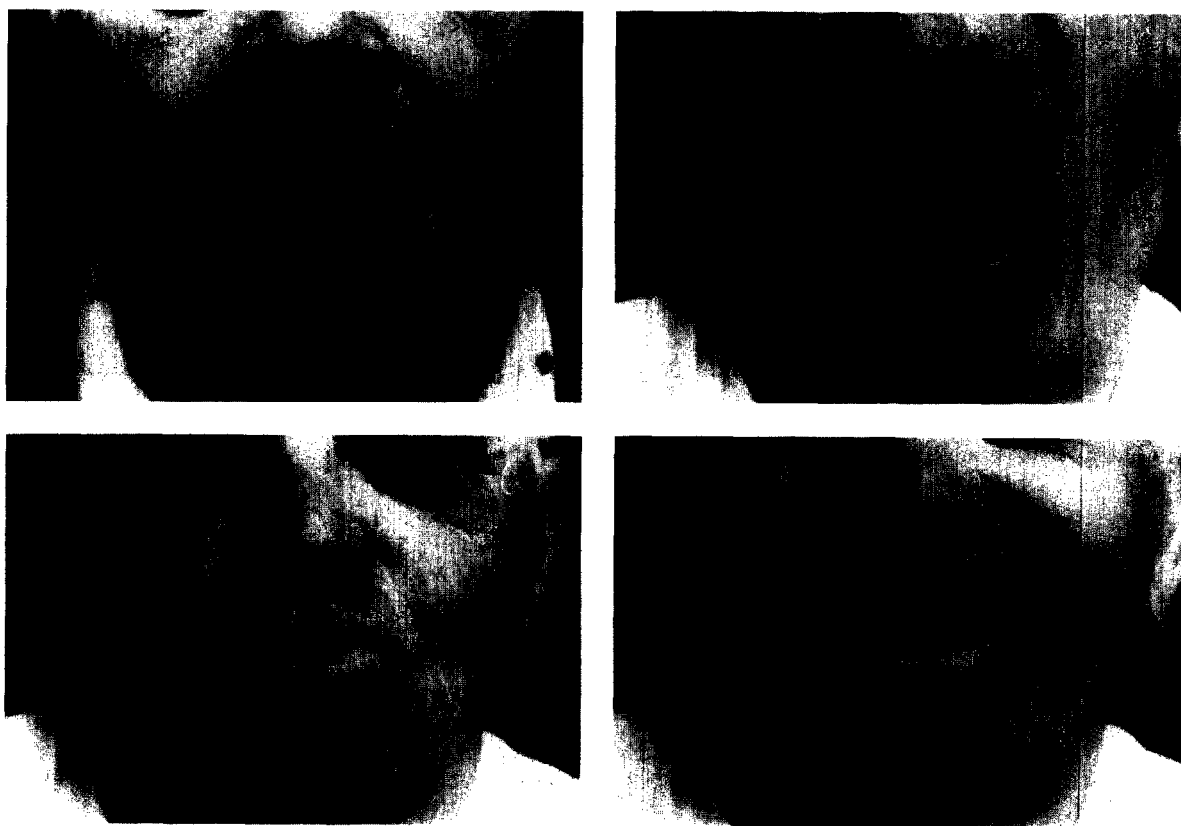


Fig. 2

Figure 2—Appearance of the lower lip treated by radiotherapy. Above left—Appearance before treatment. Above right—One year after treatment—maximum mouth opening. Below left—One year after treatment—pursed lips. Below right—One year after treatment—smiling.

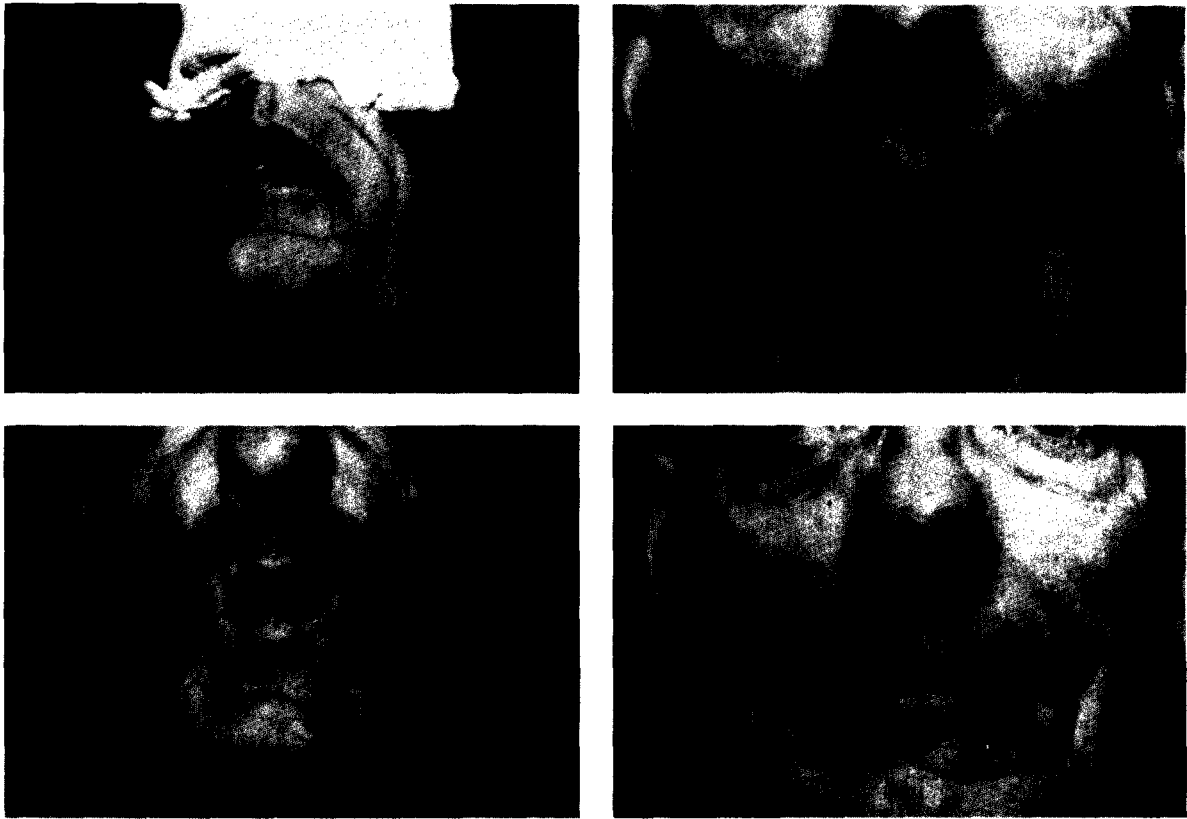


Fig. 3

Figure 3—Appearance of lip following Karapandzic reconstruction. Above left—Preoperative. Above right—One year after surgery—maximum mouth opening. Below left—One year after surgery—pursed lips. Below right—One year after surgery—smiling.

been reconstructed using the Karapandzic method. He also experienced difficulty with denture insertion.

There were no speech difficulties in patients who were treated with radiotherapy once the radiation reaction had settled. One surgical patient, aged 82, had problems with speech. He had a total lower lip reconstruction using bilateral steeple flaps.

In patients treated by radiotherapy, tissue atrophy with localised loss of substance and some deformity did occur. However, facial expression was normal in all patients (Fig. 2). For the surgical group, those patients in whom more than half of the lip was resected demonstrated a varying disturbance of peri-oral motility and a loss of symmetry in motion (Figs 3 and 4).

The preservation of intra-oral milieu, an important function of the intact lips, did not appear to be disturbed in either treatment group. Disturbance of this function is infrequently seen and only in

those rare patients where there is failure to reconstruct the lip curtain, leading to gum recession and eventual loss of teeth (Stranc and Fogel, 1984).

Discussion

Significant differences were found between the surgical and radiotherapy groups for the following parameters: lip sensation, elasticity and intercommissural distance while pursing. In every instance the values were decreased in the surgical group, while the lip parameters of individuals treated with radiotherapy did not differ significantly from normals.

Based on this it would appear appropriate, when either modality could be used to effect a cure, that radiotherapy be the treatment of choice. Surgical techniques still remain as a back-up should radiotherapy prove inadequate.

If surgery is indicated, our results show that the



Fig. 4

Figure 4—Appearance of lip following Bernard reconstruction. Above left—Preoperative. Above right—One year after surgery—maximum mouth opening. Below left—One year after surgery—pursed lips. Below right—One year after surgery—smiling.

steeple flap reconstruction produces a relatively stiff and insensate lip but adequate oral access and strong sphincteric action. It is, however, a very valuable technique for repair of defects in excess of half of the lower lip. Wedge excision of lip and Karapandzic reconstructions result in less functional disturbance, but as is well known, wedge excision can only be used satisfactorily with defects of up to one-third of the lip whereas the Karapandzic technique can cope with defects up to one-half of the lip curtain. Beyond that both techniques lead to significant microstomia.

We find it difficult to account for the consistently high pommeter values in steeple flap reconstructions but suspect that they can be explained by the bridling effect of the scar. Surprisingly, no statistically significant difference could be demonstrated between the three methods when assessing lip sensitivity. However, it must be remembered that our sample size was relatively small.

Conclusion

Most authorities agree that the cure rates following treatment of carcinoma of the lip by surgery or radiotherapy are comparable. However, previous studies have failed to analyse objectively the long-term functional outcome. Our study points to significant functional benefits when radiotherapy is used as opposed to extensive surgery. The single most important factor responsible for this is the loss of sensation in the reconstructed lip, although scarring with resultant loss of elasticity is also significant. We therefore suggest that clinicians should consider critically the potential loss of lip function when choosing a treatment modality for patients with lip carcinoma.

Acknowledgements

We would like to thank Leonie Stranc for editing this paper and, together with Mary Cheang, helping with statistical analysis.

We would also like to acknowledge Miss Penny Frank for the typing of the manuscript.

References

- Baker, S. R. and Krause, C. J.** (1980). Carcinoma of the lip. *Laryngoscope*, **90**, 19.
- Fitzpatrick, P. J.** (1984). Cancer of the lip. *Journal of Otolaryngology*, **13**, 32.
- Fogel, M. L. and Stranc, M. F.** (1984). Lip function: A study of normal lip parameters. *British Journal of Plastic Surgery*, **37**, 542.
- Heller, S. K. and Shah, J. P.** (1979). Carcinoma of the lip. *American Journal of Surgery*, **138**, 600.
- Hendricks, J. L., Mendelson, B. C. and Woods, J. E.** (1977). Invasive carcinoma of the lower lip. *Surgical Clinics of North America*, **57**, 837.
- Hornback, N. B. and Shidnia, H.** (1978). Carcinoma of the lower lip: treatment results of Indiana University Hospitals. *Cancer*, **41**, 352.
- Jorgensen, K., Elbrond, O. and Andersen, A.** (1973). Carcinoma of the lip. A series of 869 cases. *Acta Oto-laryngologica* (Stockholm), **75**, 312.
- Marshall, D. R. and Bennett, C. S.** (1982). Surgical treatment of lip cancer: The long term prognosis and functional results. *Australian and New Zealand Journal of Surgery*, **52**, 525.
- Page, R. E. and Stranc, M. F.** (1982). Normal lip function in adults. *Annals of Plastic Surgery*, **9**, 502.
- Petrovich, Z., Kuisk, H., Tobochnik, N., Hittle, R., Barton, R. and Jose, L. S.** (1979). Carcinoma of the lip. *Archives of Otolaryngology*, **105**, 187.
- Stranc, M. F. and Fogel, M. L.** (1984). Lip function: A study of oral continence. *British Journal of Plastic Surgery*, **37**, 550.

The Authors

M. F. Stranc, FRCS, Head of Plastic Surgery, University of Manitoba, Winnipeg, Canada.

M. Fogel, MD, BSc(Med), Assistant Professor, Department of Family Medicine, University of Manitoba.

S. Dische, FRCR, Head of Marie Curie Research Wing for Oncology, Mount Vernon Hospital, Northwood, Middlesex

Requests for reprints to: Dr M. F. Stranc, Health Sciences Centre, GF310-700 William Avenue, Winnipeg, Manitoba R3E 0Z3, Canada.

Paper received 2 December 1986.

Accepted 6 April 1987 after revision.