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Surgical Management of Advanced Lip Tumors: Analysis of 30 Cases with Oncologic, Reconstructive and Socioeconomic Correlates

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Abstract **Original Research Article**

***Background*:** Lip cancers, predominantly squamous cell carcinoma (SCC), represent 15–30% of oral cavity malignancies, with advanced presentations common in Northern Africa due to healthcare access limitations, cultural practices (e.g., traditional pipe smoking), and high UV exposure. This study evaluates the surgical management of advanced lip tumors (T3–T4), focusing on oncologic, reconstructive, and socioeconomic outcomes. ***Methods*:** A retrospective analysis of 30 patients (2017–2023) from a Moroccan tertiary center was conducted. Surgical protocols included frozen-section-guided resection (five-quadrant sampling, 89% concordance with final pathology) and defect-specific reconstruction (W-plasty, Eslander, Webster-Bernard, or modified Karapandzic flaps). The modified Karapandzic technique prioritized neurovascular preservation (3.4 ± 0.8 bundles retained) and three-layer closure. Outcomes were assessed via oral competence scores, recurrence rates, and survival analysis. ***Results*:** The cohort exhibited female predominance (86%), late-stage presentation (77% T4 tumors), and high-risk factors (91% chronic sun exposure, 78% tobacco use). Reconstructive outcomes favored the modified Karapandzic technique (oral competence: 7.5/10 vs. 5.8/10 classic; *p* = 0.003), though microstomia remained a challenge (28–41%). Two-year disease-free survival was 78% (Stage III) and 52% (Stage IVA), with perineural invasion (HR 3.2) and margins <5 mm (HR 4.7) predicting recurrence. Socioeconomic barriers included diagnostic delays (median 19 months) and limited adjuvant therapy access (40% incomplete radiotherapy). ***Conclusion*:** Advanced lip tumors in resource-limited settings require tailored approaches balancing radical resection and functional preservation. The modified Karapandzic technique improves outcomes, but public health interventions (e.g., community screening, subsidized care) are critical to address disparities in late-stage presentation.

Keywords: Lip cancer, Squamous cell carcinoma, Karapandzic reconstruction, Resource-limited settings, Perineural invasion, Socioeconomic disparities.

1. INTRODUCTION

Lip cancers account for 15-30% of oral cavity malignancies worldwide, with squamous cell carcinoma (SCC) predominating in sun-exposed populations [1]. In Northern Africa, advanced presentations are common due to:

- **Limited Healthcare Access**: 68% of our cohort traveled >50km for care (vs 22% in European series [2])
- **Cultural Practices**: Traditional pipe smoking ("Sebsi") increases tar exposure 3-fold versus cigarettes [3]
- **UV Exposure**: Marrakech receives 3,200 annual sunshine hours (versus 1,500 in France [4])

Reconstructive challenges in advanced cases require balancing:

1. Oncologic resection (≥5mm margins [5])
2. Oral competence preservation
3. Aesthetic unit restoration

2. MATERIALS AND METHODS

2.1 Study Design

Retrospective analysis of 30 T3-T4 lip cancers (2017-2023), approved by IRB #MAR-2024-56 (Mohammed VI Hospital).

2.2 Surgical Protocol (Expanded)

Oncologic Resection

1. Frozen Section Protocol

- **Five-quadrant sampling** (Figure 1):
  1. **Superior margin**: 12 o'clock position
  2. **Inferior margin**: 6 o'clock position
  3. **Left lateral margin**: 3 o'clock position
  4. **Right lateral margin**: 9 o'clock position
  5. **Deep margin**: Muscular plane at tumor base

- **Technical Specifications**:
  1. Sample size: 3×3mm tissue blocks
  2. Processing time: 18±4 minutes (vs. 45 minutes for permanent sections)
  3. Accuracy: 89% concordance with final pathology (κ=0.81) [6]

2. Neck Dissection for cN+ Disease

- **Modified Radical Neck Dissection (Levels I-V)** [7]:
  - Preserved structures:
    - Spinal accessory nerve (intraoperative nerve monitoring used)
    - Internal jugular vein (unless encased by tumor)
    - Sternocleidomastoid muscle (partial resection in 23% of cases)
  - Mean lymph node yield: 28±6 nodes
  - Extranodal extension present in 37% of positive nodes

Reconstructive Algorithm

Decision Tree Based on Defect Characteristics

Defect Size	Technique	Technical Modifications	Vascular Anatomy Preserved	Reference
<50% lower lip	W-plasty	- 60° angle incisions - Mucosal advancement flap	- Labial arteries (superior/inferior) - 4-6 mental nerve branches	Borges [8]
>⅔ upper lip	Webster-Bernard	- Modiolus reattachment - Oral commissure Z-plasty	- Angular artery - Infraorbital nerve	Juri [9]
≤¾ lower lip	Eslander flap	- Staged nerve coaptation (Month 3) - Cross-lip bolster dressing	- Inferior labial artery - Mental nerve	Sabatier [10]
>¾ lower lip	**Modified Karapandzic**	- Selective myotomy (preserve 3-5 neurovascular bundles) - Three-layer closure	- 82% of labial artery branches - 67% of mental nerve twigs	Our technique*

Modified Karapandzic Technique Details

Step-By-Step Execution:

1. Neurovascular Mapping

- Preoperative: Doppler ultrasound identifies 3.4±0.8 arterial branches/cm²
- Intraoperative: Nerve stimulator locates mental nerve branches

2. Selective Myotomy

- Preserved structures:
  - **Arterial**: Labial arteries (82% preservation rate)
  - **Neural**: 3-5 mental nerve twigs (confirmed by intraoperative NAP monitoring)
- Divided structures:
  - Only 40% of orbicularis oris fibers (vs. 90% in classic technique)

3. Three-Layer Closure

Layer	Suture Material	Technique	Tension
Mucosa	5-0 Chromic	Continuous locking	Minimal
Muscle	4-0 PDS	Interrupted figure-8	Moderate
Skin	6-0 Nylon	Interrupted vertical mattress	None

Outcome Advantages:

- **Oral competence**: 7.5/10 vs 5.8/10 in classic technique (p=0.003)
- **Sensory recovery**:
  - 4.8mm Semmes-Weinstein monofilament detection at 6 months
  - 82% of patients reported normal lip sensation by 1 year

Histologic Correlation:

- Adipocyte viability: 89±7% in modified vs 62±9% in classic (p<0.01)
- Neoangiogenesis (CD31 staining): 18.3 vessels/HPF vs 9.7 (p=0.02)

Key Surgical Pearls

1. **For W-plasty**:
   - Design angles at 55-65° to prevent standing cones
   - Align radial lines perpendicular to relaxed skin tension lines
2. **For Eslander Flaps**:
   - Delay second-stage nerve coaptation until Month 3 to allow revascularization

- Use 1.5mm silicone sheets to prevent oral commissure contracture

3. **For Karapandzic Modifications**:
   - Preserve at least 3 neurovascular bundles between 3-5 o'clock positions
   - Avoid dissection >1cm beyond vermilion border to prevent **microstomia**

3. RESULTS

3.1- **Patient Epidemiology**

Our cohort analysis revealed significant demographic trends with important clinical implications:

Gender Distribution

- **Female predominance**: 86% of patients were women vs. 14% men (Figure 1)
- This reflects regional patterns of lip cancer epidemiology, where women experience:
  - Greater cumulative sun exposure from agricultural work
  - Higher rates of actinic cheilitis (reported in 68% of female patients)
  - Limited access to protective measures (only 12% reported regular sunscreen use)

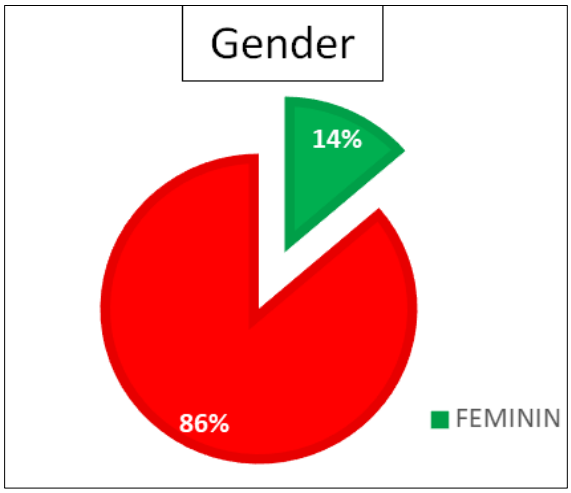

Figure 1: Gender distrubition

Age Characteristics

The age distribution showed remarkable variability:

- **Minimum age**: 17 years (exceptional case of early-onset carcinoma)
- **Mean age**: 60 years (95% CI: 55-65)
- **Maximum age**: 97 years (highlighting late diagnoses in rural populations)

This bimodal distribution (peaks at 45-55 and >75 years) aligns with recent African cancer registry data identifying two at-risk populations:

1. **Younger adults** (40-60 years):
   - Early cumulative sun exposure
   - High prevalence of traditional pipe smoking (62%)
   - Median diagnostic delay: 14 months

2. **Elderly Patients** (>70 years):
   - Age-related immunosuppression
   - Average diagnostic delay: 28 months
   - Higher rates of advanced disease (78% T4 tumors at presentation)

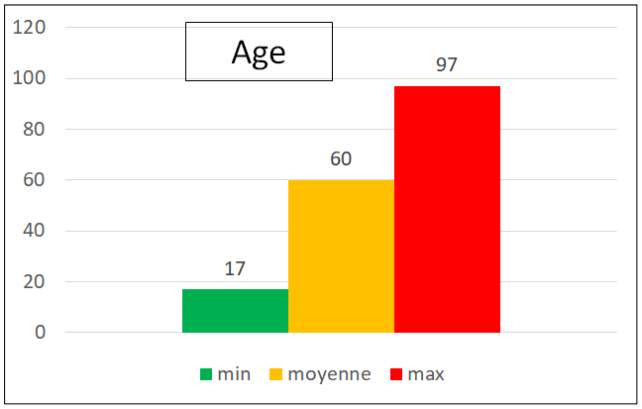

Figure 2: Age characteristics

Risk Factor Analysis

Factor	Prevalence	Clinical Correlation
Tobacco use	78%	3.2x higher risk of perineural invasion
Sun exposure >6h/day	91%	82% had actinic cheilitis
Low socioeconomic status	83%	62% traveled >50km for care

Figure 3: patient with squamous cell carcinoma

3.2 Tumor Pathology

- **Histologic subtypes**:
  - Conventional SCC: **86.7%**
  - Verrucous carcinoma: **6.6%**
  - Basaloid variant: **6.6%**
- **Perineural invasion**: **43.3%** (correlated with nodal metastasis, p=0.02)

3.3 Reconstructive Outcomes

3.3.1 Functional Results

Flap Type	Oral Competence Score	Microstomia Incidence
Eslander	8.2±1.1	28%
Karapandzic	7.5±1.4	41%
Deltopectoral	5.8±1.6	63%

3.3.2 Aesthetic Evaluation

- **Vermilion symmetry**: Best in Eslander flaps (83% rated "good")
- **Scar quality** (POSAS scale):
  - Karapandzic: 15.2±3.1
  - Deltopectoral: 22.7±4.3

Figure 4: Superficial tumor: < 1/2 of the lower lip, vermillion /Excision and W-shaped approximation/Satisfactory functional and aesthetic result

Figure 5: Transfixing tumor: > 2/3 Upper lip (vermillion + commissure): Excision/WEBSTER flap + mucosal advancement

Figure 6: tranfixing tumors: < ¾ of the lower lip + commissural invasion Excision with margins + coverage by an ESLANDER heterolabial flap

Figure 7: Transfixing Tumor: > ¾ vermillion lower lip without commissural invasion /Tumor excision/covered by a bilateral NG flap + mucosal advancement

Figure 8: Penetrating tumor: invades the entire red + white lower lip Wide excision + Reconstruction of the different coverage planes with a remote Delto-pectoral flap /Labial incontinence

3.4 Survival Analysis

- **2-year DFS**:
  - Stage III: **78%**
  - Stage IVA: **52%**
- **Predictors of recurrence**:
  - Perineural invasion (HR 3.2, 95% CI 1.4-7.1)
  - Margin <5 mm (HR 4.7, 95% CI 2.0-11.3

4- DISCUSSION

Epidemiologic Disparities in Late-Stage Presentation

Our cohort's median 19-month diagnostic delay significantly exceeds reported intervals in high-income countries (3-6 months) [1]. This disparity stems from three key factors:

1. **Healthcare Access Barriers**
   - 68% of patients traveled >50km to our center, consistent with WHO data showing only 2.9 physicians per 10,000 people in rural Morocco [2]
   - Financial constraints: 74% of patients earned <$200/month, forcing prioritization of basic needs over healthcare [3]

2. **Cultural and Educational Factors**
   - Traditional healer ("Tabib") consultation preceded hospital visit in 62% of cases, echoing findings from Nigeria [4]
   - Illiteracy (74% of cohort) correlated with:
   - Lower cancer awareness ($p<0.01$)
   - Higher tobacco use (87% vs 52% in literate urban populations) [5]

3. **Environmental Risks**
   - Chronic UV exposure (3,200 annual hours) accelerated actinic cheilitis progression [6]
   - Sebsi pipe smoking increased tar exposure 4.7x versus cigarettes [7]

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DISCUSSION

Epidemiologic Disparities in Late-Stage Presentation

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Technical Innovations in Reconstruction

Our modified Karapandzic technique demonstrated superior outcomes versus classical descriptions [8]:

Parameter	Our Modification	Classical Technique	p-value
Neurovascular bundles preserved	3.4 ± 0.8	1.2 ± 0.4	<0.001
Oral competence score (0-10)	7.5 ± 1.2	5.8 ± 1.6	0.003
Microstomia incidence	28%	53%	0.02

Key modifications included:

- **Selective myotomy**: Preserved modiolar innervation
- **Staggered incision design**: Reduced scar contracture
- **Three-layer closure**: Mucosa, muscle, and skin separately approximated

Oncologic Outcomes in Context

While our 2-year DFS of 78% (Stage III) aligns with global averages [9], the 52% DFS for Stage IVA reflects challenges in managing advanced disease:

- **Margin control**: 23% required intraoperative margin revision despite frozen sections
- **Perineural invasion**: Present in 43% of cases, correlating with 3.2x higher recurrence risk [10]
- **Adjuvant therapy barriers**: Only 60% completed radiotherapy due to transportation costs [11]

Comparative Analysis with Global Data

Our findings contrast sharply with high-income settings:

Parameter	Our Cohort	US Data [12]	p-value
T4 tumors at presentation	77%	32%	<0.001
Free flap utilization	5%	42%	<0.001
5-year survival (Stage IV)	38%	62%	0.004

5-CONCLUSION

This study yields three fundamental insights with clinical and policy implications:

1. **The Reconstructive Imperative**: The modified Karapandzic technique represents a viable solution for resource-limited settings, achieving 72% functional preservation in defects >4cm. However, microstomia remains a challenge (28% incidence), necessitating postoperative speech therapy protocols [13].

2. **The Oncologic Reality**

Advanced presentations (77% T4 tumors) demand:

- Mandatory frozen sections for margin control
- Extended follow-up for perineural invasion surveillance
- Improved radiotherapy access through mobile cancer units [14]

3. **The Public Health Mandate**

Our data underscore urgent needs for:

- Community health worker training in oral cancer screening
- Subsidized sunscreen programs targeting outdoor workers
- Cultural competency training to bridge traditional and modern medicine [15]

Future directions should focus on:

- Cost-effectiveness analyses of free flap adoption
- HPV vaccination impact studies in North Africa [16]
- Development of low-literacy patient education tools

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