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Research Article

Malignant Tumors of Foot and Our Experience: A Case Series

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Abstract

Background: Tumors involving foot are rare to encounter, challenging to manage, and not adequately addressed in the literature. Many institutes are lacking behind in handling such cases. Our study highlighted the issues faced and elaborated on the steps involved in the management of foot tumors.

Objective: To share our experience regarding presentation, management, and functional outcome of foot tumors.

Methodology: This was a retrospective case series done at Jinnah Burn and Reconstructive Surgery Centre, Lahore, from January 2017 to April 2020. Eleven patients with foot tumors were retrospectively identified. We reviewed the following details from each patient's record: Duration of presentation, prior treatments, histological type, grade/stage of the tumor, surgical management, oncological and functional outcome using MSTs (Musculoskeletal tumor society 1987).

Results: Out of eleven patients, five (45.4%) were males and six (54.5%) were females, with a mean age of 48 + 11.8 years. The mean duration of postoperative follow-up was 24.3 + 7.8 months. Histological diagnosis was Squamous Cell Carcinoma (SCC) (n=4), SCC (Marjolin) (n=2), Melanoma (n=3) and Sarcoma (n=2). All tumors were treated with excision under frozen section control and immediately reconstructed with Split thickness skin graft (STSG) in 5 (45.4%) patients, pedicled medial planter in 2 (18.1%), and free Anterolateral thigh flaps (ALTF) in 2 (18.1%). Limb salvaged in all patients except 2 (18.1%) who need a trans-metatarsal amputation. The MSTs 1987 scores averaged 24.5 + 8.6. out of a possible 35 points.

Conclusion: Tumors of the foot are rare to encounter but timely referral to specialized center for appropriate treatment results in good functional outcomes.

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Keywords | Frozen section, foot tumors, amputation

Introduction

Soft tissue tumors may occur all over the body, however, due to relative proportions of the tissue from which it originates, most occur in the trunk and proximal extremities. Although not always the case, most soft tissue neoplasms may also arise in the deep and superficial soft tissue of foot.¹ Data from various studies have shown that musculoskeletal tumors arising at the foot account for about 5-10%.²

Squamous cell carcinoma (SCC) rarely occurs in the

foot.^{3,4} It arises in keratinocytes or from precursor lesions and may also originate as de novo.⁴ Literature reports that 13% show up in lower extremities. Among the soft tissue tumors of the foot, SCC is most common, with a slightly greater incidence than melanoma and synovial sarcoma.⁵ Marjolin ulcers are tumors (usually SCC) that arise in pre-existing scars and at the site of chronic inflammation, which reflects the malignant degeneration of tissues. They appear on the plantar side of the foot more frequently and rarely in the toes.⁶

Another challenge for the clinician is the management of foot melanoma which account for 3–5% of all melanoma. Prognostic variables guiding melanoma management of foot have not been adequately evaluated by the literature, as the guidelines are based upon the melanoma arising from trunk and extremities.⁷

Sarcoma of foot involving soft tissue and bone is also a rare entity.⁸ Data from Mayo Clinic revealed a total number of 5124 bone sarcomas out of which foot region accounted for only 1.2%.⁹ Due to the rarity of this condition, a limited number of articles reviewed the prognostic value regarding the clinical outcome of patients with bone and STS of foot.⁹

Although, on this subject, there are enough publications in the literature, many health care providers are still unfamiliar with it, hence the delay in diagnosis and treatment.⁶ Therefore, there is inadequate reporting on disease process and lack of optimization of treatment strategies. The purpose of our study was to share our experience of dealing with tumors of the foot, with emphasis on presentation, surgical management, and functional outcome of this relatively rare condition.

Methods

This study was performed at Jinnah Burn and Reconstructive Surgery Center, Lahore, over a period of 3 years and 3 months (January 2017 to April 2020). After approval of the Institutional Review Board, a retrospective review of all patients (regardless of age and gender) with tumors involving the foot was performed, who were treated surgically by the lower limb team at our center. Demographics such as gender and age were recorded. Data included symptom duration, size of the lesion, tumor type (SCC, sarcoma, melanoma), unplanned excisions or biopsies, and surgical and adjuvant treatment (chemotherapy and radiation). Complications following surgery, the outcome of oncological treatment (local recurrence or metastasis, and death from disease), and functional outcomes as evaluated by Musculoskeletal Tumor Society scores were reviewed.¹²

All patients were subjected to routine physical examination and staging of disease. X-rays and MRI of foot was done to see the extent of local involvement. A CT scan of the chest and abdomen was done to check the metastasis. The diagnosis was confirmed by an Incisional biopsy. After the MDT meeting, surgical treatment was carried out accordingly.

Standard treatment protocol was followed, and all

tumors were excised under frozen section control. SCC was excised with 2cm margin, Marjolin with 4cm, melanoma was excised according to Breslow thickness, and sarcoma with wide local excision (3 cm margin). All the wounds were covered with split-thickness skin graft and flaps accordingly. Later on, all were advised to follow-up with the radiation and medical oncologist with the biopsy report.

We assessed functional outcome by using the musculoskeletal society score (MSTS 1987). It consists of 7 components which include pain, motion, stability, strength, deformity, functional activity, and emotional acceptance. The total score ranges from 0-35 with each component scored from 0-5. A higher score is attributed to good functional outcomes.

The data was analyzed using SPSS version 20. Quantitative variables like age, duration, size of the lesion, and follow-up months were evaluated in terms of mean and standard deviation. Frequency and percentage were evaluated for qualitative variables. The potential relationship between prior treatment and symptoms duration with local recurrence was evaluated by using the Pearson Chi-square test.

Results

Total 11 patients were identified, among them 5 (45.4%) were males and 6 (54.5%) females. Mean age of patients was 48+11.8 years. Duration of postoperative follow up was 24.3 + 7.8 months. Unplanned excision prior to referral were 7 (63.6%) while 4 (36.3%) patients received were not treated before. Out of 11 patients, 3(27.2%) had regional metastasis at time of presentation. The histological diagnosis of tumors were SCC (n = 4), SCC (marjolin) (n=2), invasive melanoma (n=3), and sarcoma (clear cell and spindle cell lesion)(n=2). The location of tumor was hind foot (n = 5) midfoot (n= 3) and fore-foot (n=3). Regarding size of lesions, 3 were <5 cms, 6 were between 5 – 10cms, and 2 were > 10 cm. The average duration of symptoms was 29.5+7.8 months.

Surgical management consisted of excision of the tumor followed by immediate reconstruction. This was in the form of split-thickness skin graft in 5(45.4%) patients, local flaps (medialplanter) in 2 patients (18.1%), while 2 (18.1%) patients required free flap (ALTF)(figure 1). Limb salvage was achieved in all patients except in 2 (18.1%) who needed amputation (trans metatarsal amputation and choparts amputation).

Neoadjuvant chemotherapy was not offered in any

patient.⁴ patients received post operative chemo and radiotherapy. A total of four patients experienced post-operative complications: three (27.2%) patients had a small patchy loss of split-thickness graft that was managed with topical antibiotics cream; one (9.0%) patient had a small necrotic patch over the stump that was managed successfully with debridement and allowed

to heal secondarily. The average MSTs 1987 scores of all patients was 24.5 + 8.6(out of a total of 35).

Demographic data including presentation, diagnosis, management, and functional outcome of all 11 patients are presented in Table 1. Figure 1 and 2 show representative cases.

Table 1: Clinical Characteristics and Treatment Details of all Patients

S. No	Age/ gender	Tumor type	Size (cm)	Symptom duration (months)	location	Prior treatment	Operative treatment	Chemo/ radiation therapy	Local recurrence	Follow-up (months)	MSTS
1	37/F	SCC	13	36	Hindfoot	Inadequate excision	WLE (2cm)/ STSG	Yes	yes	6	died
2	26/M	scc	4	19	Forefoot	None	WLE (2cm)/ STSG	No	No	31	30
3	60/F	scc	5	26	Hindfoot	Biopsy	WLE (2cm)/ STSG	No	No	26	28
4	41/M	STS	5	15	midfoot	None	WLE (2cm)/ STSG	No	No	23	30
5	57/F	scc	8	24	midfoot	None	WLE (2cm)/ STSG	No	No	30	30
6	45/M	STS	8	34	midfoot	Biopsy	WLE (3cm)/ ALTF	Yes	No	14	26
7	55/M	melanoma	6	38	Hindfoot	Inadequate excision	Choparts amputation	No	No	27	25
8	38/F	melanoma	2	35	Hindfoot	None	WLE (2 cm)/ medial plantar flap + RLN	Yes	No	25	28
9	52/M	melanoma	5	26	Hindfoot	Debridement	WLE (2 cm)/ medial plantar flap + RLN	Yes	No	30	27
10	55/F	SCC (marjolin)	7	35	Forefoot	Biopsy	WLE (4 cm)/ALTF	No	No	26	25
11	65/F	SCC (marjolin)	15	37	Forefoot	Debridement	Trans-metatarsal amputation	No	No	30	21

M=male, **F=**female, **SCC=** squamous cell carcinoma, **STS=**soft tissue tumor, **WLE=**wide local excision, **ALTF=**antero-lateral thigh flap, **RLN=**regional lymph node



Figure 1. (a): Melanoma Heel, (b): Medial Planter Artery Flap After Tumor Excision And Donor Site Covered With Stsg, (c): Sentinel Lymph Node Dissection



Figure 2. (a): Sarcoma Foot, (b): Tumor Excised, (c):free Alt Flap

Discussion

Our study exclusively highlighted the presentation, surgical management, and outcomes of soft-tissue tumors involving the foot. Generally, the number of musculoskeletal tumors are very less, the total number of true neoplasia of the foot and ankle is small. Although the compact anatomy should facilitate early detection of tumors of the foot and ankle, the correct diagnosis is often missed due to a lack of awareness of these entities. Additionally, the malignant potential of a tumor on the foot is often underestimated.¹⁰

In our study, 7 (63.6%) patients were received in OPD after prior unplanned excision. Many tumors show indolent potential, which makes the clinician perceive a false impression of benignity that ultimately prompts inappropriate surgical management.¹¹ Giuliano and Eilber¹² created the phrase “unplanned total excision” regarding the attempted entire excision of STS without suitable imaging or biopsy and without taking care of recommended surgical margins which resulted in positive residual disease in almost one-half of excised tumors. Thacker and colleagues extracted similarly high rates (67% and 56%) in patients who underwent unplanned excisions, ensuing greater reconstructive and radiotherapy needs and probably increased chances of local recurrence despite aggressive definitive management.¹³ With respect to oncologic outcomes, patients presenting after unplanned excisions fared worse than those who present early, with more than half of such patients reporting local progression.¹³ In our study, we found an insignificant ($P=0.62$) relationship between unplanned excision of tumors with local recurrence of the disease.

Patients mostly belong to rural areas of the country and clinicians are unaware of these rare entities, therefore presenting to tertiary care facility very late. The meantime of presentation to lower limb OPD was 29.5 ± 7.9 months. The late presentation resulted in progression and worsening of disease ($p=1.92$). Despite vast literature, and years of education regarding the importance of timely assessment of soft-tissue masses, there is still an obvious need to educate health workers who manage these patients primarily.

Limb salvage has evolved as a standard of care for most STS of the limbs. Habib, et al.¹⁴ in their study advocated 80% of tumor surgeries being done with the principle of limb salvage. It has now emerged as the norm in the management of musculoskeletal tumors

without compromising the survival and recurrence of the tumor. We also tried to spare the limb in 9(81.8%) patients out of 11. The key points of optimal management of soft tissue tumors are appropriate biopsy, correct diagnosis, accurate staging of the tumor, effective planning and execution of surgery, rational usage of adjuvant therapies, and surveillance after resection. These can be carried out effectively by a multidisciplinary team (MDT) at a tertiary care center, which along with the plastic surgery team, specializes in the care of tumor patients, with the aim of limb salvage, using complex techniques of flap reconstruction. We did a free ALT flap in 2 patients and pedicle medial plantar flap in 2 patients. We did amputation in 2(18.1%) patients where tumor involved underlying bony structures.

Regarding the management of all tumors of the foot, we always did resection of the tumor under frozen section control with recommended margins. We excised SCC with 2cm margins, marjolin with 4cm, melanoma according to Breslow thickness of the tumor, and sarcoma with 3 cm margins.^{6,15,16,17} Frozen section provides a rapid assessment of the extent of disease, and allows achievement of negative margins.¹⁸ We believe that once the primary tumor with microscopic free margins is excised, the chances of local recurrence of disease are minimum. Although the follow-up period was short (minimum 6 months), our study only had one patient with local recurrence. Most localized soft tissue sarcomas of extremity are best treated surgically with or without radiation therapy. Chemotherapy is usually reserved for patients with metastatic disease or less commonly for local tumor down-staging for very extensive lesions which might not otherwise be amenable to limb-sparing surgery.¹⁹ For SCC, radiotherapy is indicated only for local control of disease, while the efficacy of chemotherapy is still debatable. Generally for melanoma, Shaikh et al¹⁹ reported 4.98% sentinel lymph node positivity, and another research has reported 20.6% to 23.6% positive lymph node involvement.²⁰ We noted a significantly high rate of 66.6% (2 out of 3 patients) of positive sentinel lymph nodes in our study of foot melanoma.

The limitation of this study is that it has a small sample size. Further studies can be conducted on a larger scale. Moreover, different types of tumors can be separately addressed.

Conclusion

Tumors of the foot are frequently subject to inappro-

priate initial treatment, delaying both diagnosis and definitive procedure, and potentially compromising outcomes. Most patients are candidates for complete or partial limb salvage, with generally good oncologic and functional outcomes. If such patients are referred early to a specialized center, a good prognosis would be achieved by following the basic oncoplastic reconstructive principles to treat tumors of the foot.

Conflict of Interest

None

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Research Article

Correction of Congenital Clapsed Thumb Deformity Type 1 & 2: A Case Series

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Abstract

Introduction: Congenital clapsed thumb is a hereditary flexion and adduction deformity that is akin to a wide variety of structural abnormalities. Timely diagnosis of the deformity is critical for initiating treatment protocol and improving functionality of the hand.

Objective: To discuss the treatment protocol of type 1 and type 2 clapsed thumbs and their outcomes.

Methodology: This prospective case series was conducted at Department of Plastic & Reconstructive surgery, Dow University of Health Sciences & Dr. Ruth K.M. Pfau Civil Hospital Karachi from June 2016 to May 2020. A total of 10 patients (16 thumbs) with Type 1 and Type 2 clapsed thumb deformity were included; while 4 anomalous cases were excluded. Thorough family, pre-natal and ante-natal history and clinical examination were done. Involvement of unilateral/bilateral hand and disease severity was noted, and data was recorded on a proforma. Type 1 thumb with early presentation was given conservative treatment with splints. Type 2 thumb with web-space contractures was treated surgically with contracture release, tendon transfer and k-wires. Patients were followed for 12 months post treatment.

Results: Out of 16 thumbs treated in the study, 5 (31.3%) were given non-surgical treatment while 11 (68.7%) were given surgical treatment. Non-surgical treatment with splint alone was successful in 4 patients with satisfactory results, 1 thumb required surgical intervention later. All 11 thumbs subjected to surgical intervention showed improvement and satisfactory outcomes. 1 required re-correction later.

Conclusion: Despite being a progressive disease, congenital clapsed thumb can be managed successfully if timely diagnosis and treatment is initiated. The function of the hand can be drastically improved. Properly planned treatment gives satisfactory results.

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Keywords | Clapsed thumb, Weckesser classification, plaster cast, contracture, tendon transfer.

Introduction

Congenital clapsed thumb is an advancing flexion and adduction deformity of thumb that may present as part of a syndrome like arthrogryposis, digitolar-dysmorphism, and Freeman-Sheldon syndrome and is associated with various anomalies.¹⁻³ It may present as a separate entity as well. It is primarily characterized by absence or severe attenuation of extensor pollicis-

brevis (EPB), extensor pollicis longus (EPL) with the involvement of abductor pollicis longus (APL) leading to a tightly flexed, adducted thumb manifesting as varying degrees of first web space contractures and MP joint instability.^{4,5}

The diagnosis of this disease can be delayed due to normal position of the thumb inside the palm during first three months of life. However, early diagnosis

and treatment are imperative. If not corrected before cortical functional development, child adapts to the disuse of thumb that severely affects the functionality of hand and the quality of life in the long run.^{6,7}

Weckesser et al in 1968 described a classification system of this anomaly into four types.² Multiple treatment options are available depending upon the age at presentation, severity of the disease and associated structural deformities. Conservative treatment with splinting provides good functional outcome in supple thumbs that present early, before the age of one year; while surgical correction is reserved for neglected or severe cases presenting with associated web contractures.⁸

The Objective of this study is to discuss the treatment protocol of type 1 and type 2 clasped thumbs and their outcomes.

Methods

A prospective study was conducted at the Department of Plastic & Reconstructive Surgery Dow University of Health Sciences & Dr. Ruth K. M. Pfau Civil Hospital Karachi, from June 2016 to May 2020. Children aged between 3 months to 3 years with Type 1 and Type 2 clasped thumbs with unilateral or bilateral involvement were included in the study while children with Type 3 and type 4, complicated with heterogenous anomalies in addition to thumb, already defective cortical function (cerebral palsy), severe medical diseases and other systemic or musculo-skeletal congenital anomalies were excluded.

After taking written and informed consent from parents, patients fulfilling the inclusion criteria were enrolled in the study. They were subjected to thorough physical and radiologic evaluation using a proforma by the senior surgeons. Detailed family, prenatal and antenatal history was obtained. All patients were followed for 12 months post-intervention. For the ease of data collection and treatment implementation, deformed thumbs were divided into two main groups based on age at presentation and disease severity (according to Weckesser classification Type 1; supple, and Type 2; complex).

Group A: early presentation (before 1 year of age) and supple type 1 deformity

Group B: late presentation (after 1 year of age) and complex type 2 deformity.

Statistical Analysis: Statistical Package for Social Sciences (SPSS) version 24 was used for the analysis of obtained data.

Treatment Protocol

Non-surgical: Patients who presented early with supple type 1 deformity were offered full time splinting of thumb in extension and abduction for six months. Plaster cast was changed at 6-8 weeks, taking into consideration the growth of the hand. Plaster splint at night was continued for another 6 months after gaining full active extension (Figure-1)

Surgical treatment: Surgical intervention was offered to cases that presented late, or with complex type 2 thumbs with joint and web space contractures. Surgery was also offered to cases that failed to respond to splintage alone. The basics of reconstruction included release of the narrowed web space using simple Z-plasty in almost all cases, with 3 cases requiring coverage of the skin defect with a dorsal rotation advancement flap. All the tight structures including the fascia overlying thenar muscles were identified and released. Tendon transfer was done to achieve active extension of thumb at the first Metacarpophalangeal joint. Extensor indicis-proprius (EIP) was the donor tendon used. It was found through a small incision over the dorsum of second MCPJ, tenotomized, re-routed and passed through a subcutaneous tunnel to be transferred to extensor mechanism of thumb or attached to the base of proximal phalanx. If EIP was absent, a slip of flexor digitorum-superficialis (FDS) was used. The thumb was held in extension and abduction stabilizing the MP joint with two cross k-wires.

The hands were kept in a plaster cast and k-wires were removed after 6 weeks. After that, night splint was continued for six months post operatively in extension and dynamic use of thumb was advocated during the day (Figure-2).

Outcome Assessment

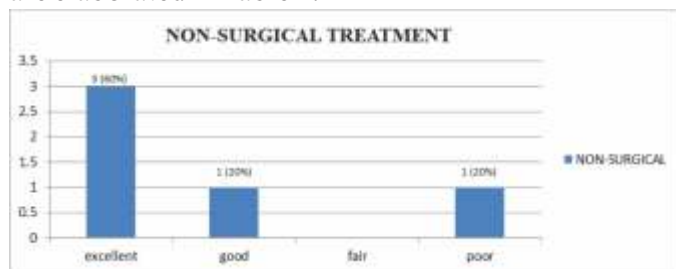
Outcome was assessed on following criteria

- (i) parents' satisfaction regarding appearance and position of thumb
- (ii) opening of the webspace
- (iii) scars
- (iv) function of thumb according to Gilbert's grading system – degree of opposition of thumb during grasping different objects.

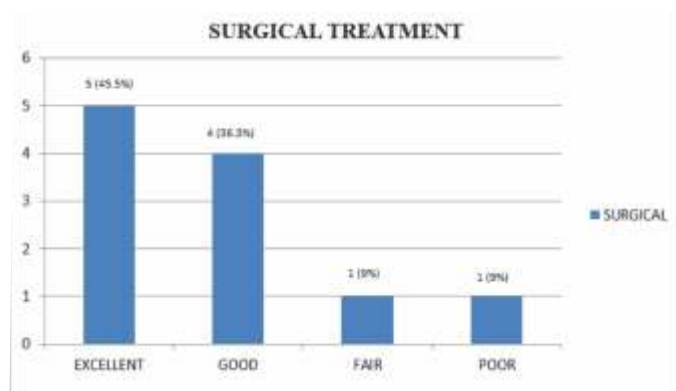
Results

A total of 10 patients (16 thumbs) were included in the study, seven (70%) patients were male and three (30%)

were female. six (60%) had bilateral thumb involvement and four (40%) had unilateral involvement. Mean age (\pm SD) was 14.6 ± 9.61 months (range: ≥ 3 months – 36 months). All patients were followed for 12 months post treatment. Out of 16 thumbs included in the study, 5(31.3%) were offered non- surgical treatment with splintage while 11(68.7%) were offered surgical intervention. Patient details regarding diagnosis and treatment are elaborated in Table 1.



Graph 1: Non-Surgical treatment of Clasped Thumb Deformity



Graph 2: Surgical Treatment of Clasped Thumb Deformity

All of our patients’ parents were satisfied with the results as the position of thumb out of the palm alone improved the appearance and functionality of the hand. Functionality was assessed using the Gilbert’s grading system considering the degrees of abduction, rotation and opposition of thumb. Out of 3 patients (5 thumbs) non-surgical treatment with splintage alone was used with excellent outcome in 3(60%) and good in 1 (20%) thumb, such that they could pick up a pencil and key or hold a ball with full active extension of thumb at all joints. Unsatisfactory outcome (poor, according to Gilbert’s chart) was found in 1 thumb (20%), which required surgical correction at alater stage. All 11 thumbs subjected to surgical intervention showed improvement. 5 (45.5%) operated thumbs had excellent, 4(36.3%) had good, 1(9%) had fair and 1 (9%) had poor outcome. Graphs 1 and 2 depict outcomes of non-surgical and surgical intervention for clasped thumb, respectively.



Figure 1: Plaster Cast Applied for a Type 1 Deformity with thumb Held in Abduction and

Table 1: Patients' thumb involvement, types of deformity and the treatment offered

Thumb involvement	Type of deformity	Treatment
Unilateral	1	Splintage
Unilateral	2	Webspace release(z-plasty), intermetacarpal & adductor fascia release, tendon transfer, k-wiring
Unilateral	2	Webspace release(dorsal rotation advancement flap), intermetacarpal & adductor fascia release, tendon transfer, k-wiring
Unilateral	2	Webspace release(z-plasty), intermetacarpal & adductor fascia release, tendon transfer, k-wiring
Bilateral	1	Splintage
Bilateral	1	Splintage
Bilateral	2	Webspace release(z-plasty), intermetacarpal& adductor fascia release, tendon transfer, k-wiring
Bilateral	2	Webspace release(z -plasty), intermetacarpal fascia release,adductor muscle release from 3 rd metacarpal, tendon transfer, k-wiring
Bilateral	2	Webspace release(dorsal rotation advancement flap), intermetacarpal & adductor fascia release, tendon transfer, k-wiring
Bilateral	2	Webspace release(dorsal rotation advancement flap), intermetacarpal fascia release, adductor muscle release from 3 rd metacarpal, tendon transfer, k-wiring



Extension

Figure 2: Surgical release of Type 2 deformity. (a) The contracted 1st webspace was released using simple z-plasty (b) EIP tendon was identified and release from its attachment into extension expansion of index finger, re-directed for transfer to the thumb, (c) EIP attached to the base of proximal phalynx and k-wires used to hold thumb in extension and abduction.

Discussion

Congenital clasped thumb is a hereditary flexion and adduction deformity that manifests as a wide variety of structural abnormalities. First case was described by Tamplin in the early 1840's. It is defined by the lack or attenuation of the extensor mechanism of the thumb with varying degrees of web space contracture and MP joint instability.^{1,3,5}

The exact cause of the disease remains unknown but studies have suggested a strong genetic predisposition with incidence of positive family history of 32.5% as reported by Tsuyuguchi et al and Ghani et al®. The disease is more common in males than in females with a ratio of 2.5: 1% as reported by Ghani et al and Lin et al®. with a high incidence of bilateral thumb involvement.^{3,9} Similar pattern of inheritance with positive family history and consanguinity was found in about one-third of cases in our study. Male pre-dominance (70%), and high percentage of bilateral thumb involvement (60%) seen in our study was similar to that reported by Tsuyuguchi et al.¹⁰

Various classification systems have been devised to categorize the disease with its broad spectrum of anomalies. Most widely used classification systems were proposed by McCarroll and Tsuyuguchi. Weckesser et al provided a classification system that divided the disease in 4 types depending on the severity of defor-

mity.^{2,8}

We used the classification system proposed by Weckesser et al and our treatment protocol was according to Weckesser et al, Lipskeir and Weizenbluth and McCarroll who divide the deformity in two type (supple –type 1 and complex–type 2 with webspace contractures). Supple type was primarily treated with splintage for up to 6 months with thumb held in abduction and extension. The complex type was offered surgical treatment with correction of the contracture and reconstruction of the extensor mechanism of thumb.^{9,11,12}

In this study 31% (5 out 16 thumbs) patients were treated with splintage alone and yielded satisfactory results similar to those reported by Ghani et al and Tsuyuguchi et al, while 68.7% (11 out 16 thumbs) were treated surgically.^{8,13} We also noted that the severity of the structural pathologies was mostly dependent on the age of patient at the time of surgery. The corrective and reconstructive options ranged from simple z-plasty in most cases and coverage of the skin defect with dorsal rotation advancement flap to release of adductor fascia and muscle when required. The thumb was held in abduction and extension with the help of two cross k-wires.^{14,15,16}

There is no unanimously accepted method for the analysis of treatment outcomes due to difficulty in assessment of function of thumb at the given age.¹⁶ Multiple bench marks have been identified and used in the literature for assessment of success of non-surgical/surgical treatment in terms of function and satisfaction. Some authors assessed degree of active extension of thumb, while Tsuyuguchi et al considered the degree of active abduction at the trapeziometacarpal joint.^{11,19,20} Opening of the 1st webspace was used as a reference point by Lipskeir and Weizenbluth. We used Gilbert's chart as our benchmark of assessment which is based on active abduction and opposition of thumb.^{10,17,21,22} Three out of five thumbs treated conservatively had excellent, one had good, and one thumb had poor outcome as per the grading system used in the study. All 11 thumbs that were treated surgically had satisfactory outcome.

Conclusion

In this study we found that despite being a progressive disease, congenital clasped thumb can be successfully managed if timely diagnosis and treatment is initiated. The function of the hand can be drastically improved.

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Research Article

Comparison of Patient Satisfaction of Return to Work in Early Post-operative Periods in Patients with High Radial Nerve Injury Undergoing Primary Nerve Repair Plus Tendon Transfer Versus Primary Nerve Repair Alone

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Abstract

Background: Complete nerve recovery can take 2 years or more if repaired primarily /grafted, with poorer results in proximal and extensive crush injuries. After tendon transfer, (usually done in the setting of irreparable nerve injury, inadequate functional recovery after repair, or late presentation), full activity can be resumed at 12 weeks. Our objective was to compare early return of work satisfaction level in patients with high radial nerve injury undergoing early tendon transfer combined with nerve repair, with patients undergoing nerve repair alone.

Methods: This was a non-randomized controlled trial conducted over a 2-year period (August 2017 to August 2019). All patients with high radial nerve injury, presenting within 1 year were included and divided into 2 groups. Group 1 had nerve repair with tendon transfer and group 2 had nerve repair alone. Post-operative follow-up was done at 6 and 12 weeks. Active range of motion was assessed and graded as excellent, good, fair or poor

Results: A total of 33 patients participated in the study. There were 16 patients in group 1 and 17 in group 2. The majority of patients were manual workers. At 12th week, all patients in group 1 were satisfied with the functional improvement and were able to continue their previous job. While in group 2 no improvement in function was noted in all the patients and the majority (88%) were not satisfied with recovery time and wanted to be splint-free. All the manual workers in this group expressed the desire to go back to work early.

Conclusion: Early tendon transfer at the time of nerve exploration and repair is highly beneficial and rewarding for patients, especially manual workers in terms of gain of function, return to work, and their satisfaction in performing daily activities.

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Keywords | Early tendon transfer, functional outcome, high radial nerve injury, patient's satisfaction, manual worker

Introduction

Radial nerve injury is common and usually occurs as a result of blunt or penetrating trauma especially following humeral shaft fractures due to the nerve's proximity and long tortuous course in close proximity to the bone. Gunshot injuries and iatrogenic injuries are some other commonly reported initiating events.¹ Clinical signs depend on the site of nerve

damage with a high, complete radial nerve injury presenting with loss of extension of wrist and fingers, and thumb abduction and extension, and an overall reduction in grip strength whereas in a low, posterior interosseous nerve injury (PIN injury) wrist extension is spared.^{2,3,4} The algorithm of treatment includes primary nerve repair, repair with nerve graft, nerve transfer, and tendon transfer.⁵ Results of nerve repair are disappointing in

very proximal injuries, those that require longer nerve grafts, and injuries that occur from extensive crush.⁶ Moreover, the initial signs of nerve recovery are usually late i.e. can be delayed up to 6 months while complete recovery can take 2 years or more.^{7,8} During this time patient needs to wait with a wrist extension splint applied for recovery with uncertainty about return of function.

A tendon transfer is the most reliable option to restore function after peripheral radial nerve injury and is done when the nerve is irreparable, does not recover after direct repair or with graft, and when the patient presents too late after the injury.⁷ In one study Dunnet et al concluded 84% improvement in hand function and 64% increase in power grip after reviewing 49 cases undergoing tendon transfer surgery.⁹ As per the algorithm of management of radial nerve injury, patients wait for 12 to 18 months after nerve repair for recovery. If there are no signs of recovery then tendon transfer procedure is done, increasing morbidity and overall time to return to work which has a negative effect on patients functional status, finances, and mental health. If tendon transfer is done early at the time of nerve repair, the patients can achieve full activity by the end of 12 weeks.¹⁰ This will reduce the morbidity, improve functional outcome, and enable early return to work, while allowing simultaneous nerve recovery.¹¹

The objective of this study was to compare the functional outcomes, and satisfaction level in patients with high radial nerve injury undergoing early tendon transfer combined with nerve repair, with patients undergoing nerve repair alone.

Methods

This was a non-randomized controlled trial conducted at the Department of Plastic and Reconstructive Surgery of a tertiary care hospital between August 2017 and August 2019. A total of 33 patients with high radial nerve damage were included. Patients were briefly informed about the pros and cons of both the procedures and were assigned in groups based on their choices. Patients in group 1 (n=16) underwent radial nerve repair with a full set of tendon transfer, whereas patients in group 2 (n=17) underwent radial nerve repair alone. Patients with excessive crush injury, extensive soft tissue loss, and multiple nerve injuries were not included in the study. In all group-1 patients, full set of tendon transfer was done along with radial nerve repair i.e. Pronator Teres (PT) to Extensor Carpi Radialis Brevis (ECRB), Flexor Carpi Radialis (FCR) to Extensor Digi-

torum Communis (EDC), and Palmaris Longus (PL)-rerouted to Extensor Pollicis Longus (EPL) via end to side technique while group 2 patients underwent radial nerve repair only either primary or with graft. All surgeries were performed by experienced plastic surgeons. Tendon repair was done with 2/0 non-absorbable suture with multiple weave-through technique. Postoperatively long arm splint was used with the wrist in 20-degree extension and fingers in extension for 4 weeks. Nerve repair was done under microscopic magnification with epineural repair technique using 8/0 proline suture. Post-operative management for all patients included complete immobilization with an above-elbow splint with elbow fixation at 90°, forearm mid-pronated, and wrist at 30° extension. Similarly, thumbs were kept abducted and extended and the finger's MCP joints extended keeping tension off the transferred tendon while simultaneously allowing nerve regeneration.

Post-operative follow-up for record purpose was done at the 6th and 12th. Data was collected by the end of the 12th week using a standardized questionnaire.¹² Objective assessment was made by extracting the records of physical examination done by the end of the 12th post-operative week for active range of motion at wrist, fingers, and thumb. These were divided into 4 categories for the ease and simplicity of analysis: Excellent, good, fair and poor (Table:1).¹² Subjective assessment was made on patients opinion regarding their overall satisfaction (yes/no), ability and time to return to their previous jobs (yes/no) and to perform routine activities (yes/no), and whether he/she would be willing to undergo the same operation on the opposite limb provided the same occurred to that (yes/no), from both the groups by a standardized questionnaire.

Analysis

Data were entered and analyzed in the SPSS version 20.0 statistical package. The normality assumption of age was assessed using the Shapiro-Wilk test. Frequency and percentages were calculated for categorical variables. Chi-square was used for categorical variables to assess the relationship with outcome variables. Pie and bar charts are utilized for the graphical display of results (p-value < 0.05).

Results

There were 16 patients operated in group-1 (nerve repair with a tendon transfer) out of which 12 (75%) were males and 4 (25%) females. In group 2 (nerve repair alone), there were 17 patients, out of which 13 (76.5%)

Table 1: Criteria for Grading Range of Motion of Wrist, Thumb, and Fingers.¹²

	Excellent	Good	Fair	Poor
Wrist extension	0-80°	0	45°	70°
Fingers extension	0-10°	0	45°	90°
Thumb abduction and extension	80-99°	60-80°	30-50	0-29°
Wrist flexion	Full	0-20°	0	Dorsi-flexed

were males and 4 (23.5%) females.

Regarding occupation, majority of patients in both groups were manual workers (68.8% in group A and 58.8% in group B). Figure 1 shows the occupation details of patients in both groups. Figure 2 depicts the hand dominance patterns, showing that majority of the patients were right handed (81.2% and 82.4% in group A and Group B respectively).

Mechanism of injury was penetrating trauma in 14 (87.6%), and blunt trauma in 2(12.5%) patients in group A. similarly in group B, mechanism of injury was penetrating trauma in 15 (88.2%) and blunt trauma in 2(11.8%) patients (Figure 3). 2 patients in each group has associated fracture of the humerus.

Table 2: Subjective Assessment of Activities of Daily Living

		Group-1	Group-2
Personal Care	Dressing	100 %	0.0%
	Tooth Brush	100%	0.0%
	Tap	100%	0.0%
	Cup	100%	0.0%
	Fork/Knife/ Spoon	87%	0.0%
Communication	Books	100%	0.0%
	T.V Remote	100%	0.0%
	Telephone	87%	0.0%
	Writing	75%	0.0%
Mobilization	Door (open/close)	100 %	0.0%
	Handles	100 %	0.0%
	Driving/ Riding bike	87 %	0.0%

Only patients who presented within 1 year of injury were included. In group A, 13 (81.2%) presented within 3 months, 2(12.5%) patients presented between 3-6 months, and 1 (6.2%) patient presented after 6 months of injury. In group 2, 14 (82.4%) presented within 3

months of injury, 2 (11.8%) patients presented between 3-6 months, and 1 (6.1%) patient presented after 6 months of injury.

Table 3: Subjective Assessment of Improved Quality of Life

		Group - 1	Group - 2	P-value
Able to return to work	Yes	14 (87.5%)	00 (0.0%)	0.000
	No	02 (12.5%)	17 (100%)	
Would like to opt for the same procedure in the future if needed	Yes	15(93.75%)	04(23.52%)	0.000
	No	01 (6.25%)	13(76.47%)	
Overall satisfied with the procedure	Yes	16 (100%)	02(11.76%)	0.000
	No	00 (0.0%)	15 (88.2%)	
Improved quality of life	Yes	16 (100%)	00 (0.0%)	0.000
	No	00 ((0.0%)	17 (100%)	
Willing to wait till nerve recovery	Yes	01 (6.25%)	02(11.76%)	0.000
	No	15(93.75%)	15 (88.2%)	

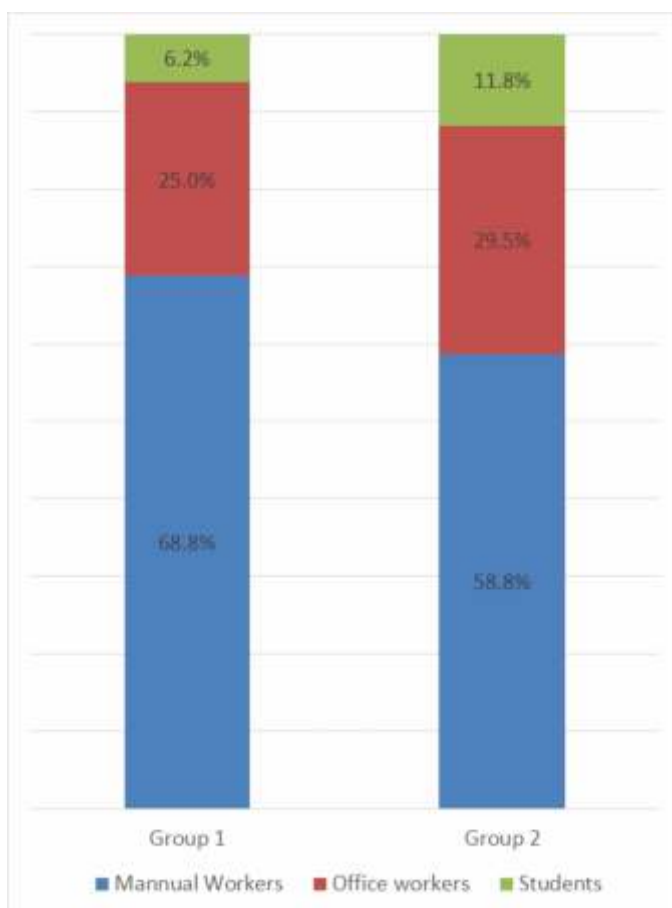


Figure 1- Occupation of Patients in both Groups

A Shapiro-Wilk test (p > 0.05) showed the age was normally distributed in group 1 patients (p-value - 0.791) with a mean of 30 ± 5.61 years (n=16), while it was not distributed normally in the group – 2 patients (p-

value -0.034) with a mean of 29.18 ± 8.09 years ($n=1$). Patients of Group-1 were satisfied with the procedure at the end of the 12th week and reported an overall enhancement in the quality of life after the procedure. The majority (95.8%) were not willing to wait until nerve recovery and were able to go back to their previous jobs. 15 out of 16 patients said they will opt for early tendon transfer if they fall in similar trauma to the other limb. Subjective assessment was done through a questionnaire. All the patients reported satisfactory improvement in activities of daily life that includes personal care, communication, and mobilization, while no patient from group 2 reported any sort of subjective improvement and were not satisfied with the procedure. The majority (93.7%) of them said they would not opt for the same procedure in future, if need be. None was able to return to their previous job after 3 months of the procedure as there was no improvement in terms of extension of wrist and finger, thumb abduction and extension, and grip strength. Table 2 compares activities of daily living between the 2 groups. Table 3 depicts subjective assessment of improvement in quality of life. All patients of group-1, showed improvement in terms of extension of wrist and fingers, and thumb abduction and extension. Significant improvement in grip strength with ulnar deviation of wrist was also noted while no improvement was noted in any patient of group 2 [Table 4]

Table 4: Objective Assessment of Range of Motion

		Group-1	Group - 2	p-value
Wrist Extension	Excellent	12 (75%)	00 (0.0%)	0.000
	Good	04 (25%)	00 (0.0%)	
	Fair	00 (0.0%)	00 (0.0%)	
	Poor	00 (0.0%)	17 (100%)	
Fingers Extension	Excellent	13(81.2%)	00 (0.0%)	0.000
	Good	03(18.8%)	00 (0.0%)	
	Fair	00 (0.0%)	00 (0.0%)	
	Poor	00 (0.0%)	17 (100%)	
Thumb Abduction	Excellent	09(56.3%)	00 (0.0%)	0.000
	Good	04 (25%)	00 (0.0%)	
	Fair	03(18.8%)	00 (0.0%)	
	Poor	00 (0.0%)	17 (100%)	
Thumb Extension	Excellent	14(87.5%)	00	0.000
	Good	02(12.5%)	00	
	Fair	00	00	
	Poor	00	17 (100%)	

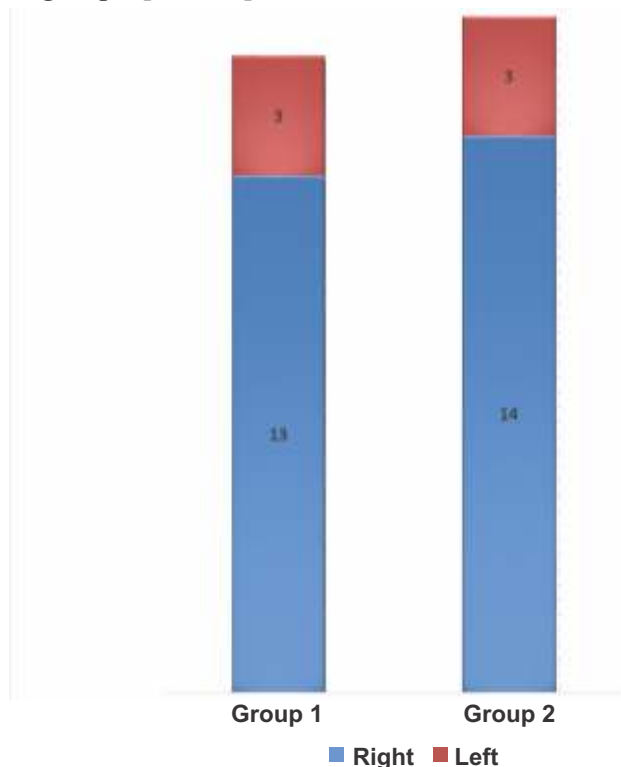


Figure 2 – Hand Dominance

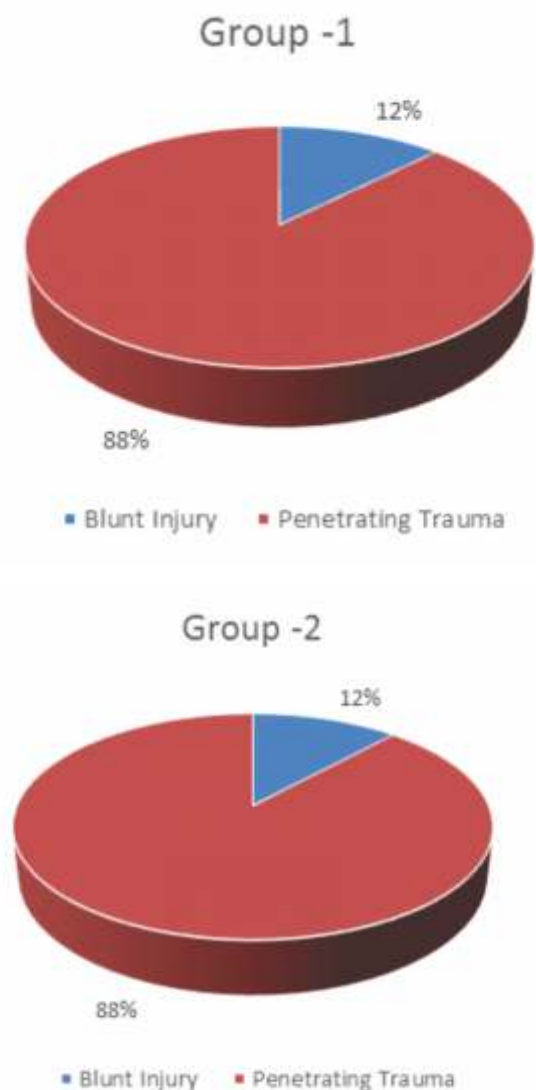


Figure 3 - Mechanism of Injury

Discussion

Peripheral nerve palsies depending on their various etiologies are known to have multiple management and treatment options. Classification of radial nerve palsy into primary or secondary nerve damage and according to the site of nerve transection into high and low radial nerve palsy is commonly used to determine surgical management options.¹³ One systematic review comparing nerve recovery as per categorization by Shao et al according to management strategies showed 77.2% nerve recovery with expectant management, 68.1% nerve recovery in cases of late surgical intervention; that is 8 weeks post-injury with unsuccessful expectant management, and 89.8% nerve recovery with early surgical intervention (injury duration-within 3 weeks).¹⁴ Surgical exploration and treatment commonly comprise neurolysis, neurorrhaphy, nerve repair by grafting, and/or tendon transfers, out of which tendon transfers are the preferred modality for reliable results.¹³

Tendon transfers have been in practice for many years and are currently indicated in high radial nerve palsy, irreparable nerve damage in high-energy trauma, failure to recover after primary repair or grafting, or in cases of late presentation with no expectation of nerve regeneration.¹⁰ A study comparing tendon transfers versus nerve transfers for restoring wrist extension displayed similar outcomes, achieving a motor score of M3-M4 and degree of wrist extension to about 0°-70°. However, tendon transfer proved to be superior when comparing recovery times between the two aforementioned surgical options.¹⁵ Current principles suggest mobilization of single joints between 4 and 6 weeks post-operatively. At 6 weeks post-operatively strengthening exercises are normally initiated and splint is discontinued, and at 12 weeks patients are expected to have a complete restoration of wrist and hand function.¹⁰

At present, tendon transfers are performed after failed primary nerve repair/graft with a minimum waiting period of 1 year for recovery.¹ For this study, everyone who presented in the clinic with features suggesting a high radial nerve transaction was considered and those who fulfilled the criteria to undergo a successful nerve repair and/or tendon transfer were included. Patients were divided into two groups as described previously. In group 1 primary nerve repair plus a full set of tendon transfer was performed at the same time, thus omitting the standard waiting time for signs of nerve regeneration whereas group 2 underwent nerve repair alone. For radial nerve repairs an end-to-end repair with epineurial micro sutures or if the gap between the two ends were

³ 3cm, an autologous nerve graft using sural nerve was preferred. Full set of tendon transfer surgery comprised of a transfer of pronator teres (PT) to extensor carpi radialis brevis (ECRB) to restore wrist extension and for thumb extension and abduction a palmaris Longus (PL) rerouted to extensor pollicis longus (EPL). For restoration of MCPJ or finger extension we preferred a Brand's flexor carpi radialis (FCR) to extensor digitorum communis (EDC) transfer as a flexor carpi ulnaris (FCU) transfer is often known to result in radial deviation of the wrist. All transfers were done in an end-to-side fashion except PL to EPL as some radial nerve recovery is still expected. The only drawback of the said transfer is that patients were unable to perform independent finger extension that will be a potential problem for typing and keyboard (piano) operators but was not an issue for manual workers.

All patients were followed up in the clinic at the 6th and 12th week post-operatively. The key step in rehabilitation of tendon transfer procedure is re-education of the muscle-tendon unit and was encouraged in all patients of group 1 starting 4th week post-operatively. Full range of motion was started after 12th week post-operatively.

It was found that by the 12th week, patients in group 1 were full weaned off the splint with complete restoration of wrist, fingers, and thumb extension and with many of them returning to their work with no difficulty and exemplary patient satisfaction. The only drawback reported was the inability to execute fine finger movement by a few patients as per their job demands. In group 2, none of the patients showed any signs of functional return at follow-up assessments. By the 12th week, except a few patients who were not manual workers, the majority showed immense dissatisfaction and wished to be splint-free.

This study affirms tendon transfers at the time of nerve exploration can be beneficial especially for manual workers who prefer avoiding long periods of disability and want to return to their work as soon as possible. Classically, the principle of a successful tendon transfer is based on transferred muscle unit reeducation through proper feedback information in achieving muscle functions that are completely different to their original function. However, performing a tendon transfer earlier has an added benefit as the transferred tendons also serve as a substitute during periods of nerve regeneration thus, providing internal splintage while simultaneously adding the bulk of normal muscle to the re-innervated muscle.^{2,16}

Moreover, with mobilization of required joints indicated

as early as 4 weeks post-operatively and proper rehabilitation and reeducation of transferred muscle unit, complications like wrist flexion contractures can be avoided that is otherwise a threat with prolonged wrist bracing.¹⁷

The only drawback of the procedure of tendon transfer is that independent finger extension would be lost, which is more of a concern for certain professions such as musicians, keyboard operators etc. Another drawback is the additional scar marks on forearm.

Limitations of the study include small sample size and the generalizability of the study, as most of the subjects were manual workers that belong to low socioeconomic status and were the only breadwinners of the family and therefore cannot wait until the nerve recovery period.

Conclusion

Early tendon transfer at the time of nerve exploration and repair, in high radial nerve injury gives admirable results in terms of function and patient satisfaction, especially in manual workers. Patients don't have to wait for nerve recovery time that is psychologically disturbing to them. The author suggests performing tendon transfer in such cases.

Conflict of Interest

None

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Research Article

Is Sural Artery Flap an Answer for Soft Tissue Coverage of Lower Limb Defects?

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Abstract

Introduction: Sural artery flap has proved to be a reliable option to reconstruct soft tissue defects of lower leg with no significant morbidity at donor site. Various modifications of flap harvesting technique like extended, delayed proximally /distally based, islanded/peninsular, nerve sparing have been described in various studies. This study highlights modifications in a single series and their outcomes in lower limb defects

Methods: This is a retrospective observational study including 35 patients of either gender conducted at Plastic Surgery Department, Services Hospital Lahore. Lower extremity defects requiring soft tissue coverage enrolled from March 2020 to March 2021 were included. Demographic data, clinical details about the defect and post-operative complications were noted. Clinical outcomes of the flap on basis of flap size, operative time, wound healing percentage and complication rate were observed.

Results: 35 patients (28 males and 7 females) of mean age of 31.62 ± 13.93 years were included in this case series. The most common cause of lower limb defects was trauma. The ankle and dorsum of foot was the most common location that was covered with extended reverse sural artery flap. Mean flap size was $131.48 \pm 29.46 \text{cm}^2$. Mean operative time was 79.71 ± 18.78 min. The complication rate was 14%. Complete wound healing was $97\% \pm 3$.

Conclusion: Sural artery flap is a reliable and versatile option for resurfacing soft tissue defects of lower limb. Various modifications can be wisely utilized to increase the efficacy of flap with lesser complications, extended coverage and less operative time especially in an era of COVID -19 infection.

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Keywords | Lower limb defects, sural artery flap, extended reverse sural artery flap, Modifications of sural artery flap, delayed reverse sural artery flap.

Introduction

Coverage of soft tissue defects around lower leg has always been a technically tough task due to scarcity of available soft tissue for reconstruction.¹ Free tissue transfer has been a great option for coverage of such defects. Nevertheless, need for sacrifice of major vessels, need for expertise, logistics and prolonged operative time are the limitations of free tissue transfer. In this era of covid-19 pandemics where prolonged operative time and lengthy hospital stay increases the risk of infection, sural artery flap proves to be a versatile and reliable option for wound coverage of lower leg.

After the description of Ponten of fasciocutaneous sural flap in 1981, Donski and Montegut further evolved the clinical application of sural artery flap as an excellent choice for coverage for lower third of leg. In 1992, Masquelet et al introduced the concept of reverse flow sural neurocutaneous flap.² The skin of posterior middle third of calf is supplied by medial and lateral superficial sural arteries which are invariably branches of popliteal artery. It is accompanied with sural nerve which provides neurocutaneous vascular plexus. Venous drainage of this region is through lesser saphenous vein. These structures courses in the midline of calf deep between

two heads of gastrocnemius and pierces deep fascia at midcalf level. The main perforating vessels of mid-calf commonly arises from medial superficial sural artery and peroneal artery. It has been described that communicating branches from the neural arterial plexus, lesser saphenous vein arterial network, the adipose arterial network are inter linked that optimizes flap perfusion. However, major contribution is provided by septocutaneousperoneal artery perforators which run into two parallel networks: one for the sural nerve and other for the lesser saphenous.³

In last few decades, multiple modifications have been published in literature. With plethora of multiple modifications, this flap can even be used for coverage of defects of larger size and can achieve longer arc of rotation for defect up to forefoot.¹² This study is aimed to evaluate the utility of different modifications of sural artery flap for more complex defects of lower leg for which free tissue transfer can be a good choice.

Outcomes were assessed in term of operative time, flap size, wound healing and complication rate. Although there are a lot of studies available in literature about this flap, however, this study will highlight the importance of less operative time and hospital stay in this phase of epidemics and shows sural artery flap as a good selection for reconstruction of lower limb defects. Moreover, in this study, we tried to infer that in spite of technically difficult defect size and site, sural artery flap proves to be a safe and reliable choice.

Methods

This is a retrospective observational study conducted at Plastic & Reconstructive Surgery Department, Services Hospital Lahore from March 2020 to March 2021. The study protocol was approved by the Institutional Review Board, Services Institute of Medical Sciences / SHL (Ref No. IRB/2021/847/SIMS). Demographic and clinical data of thirty five patients with lower limb defects recruited either through emergency or outpatient department from March 2020 to March 2021 is reviewed. Patients having complete incomplete pre-operative, per-operative findings and follow up less than 3 months were excluded. As per protocol, trauma case were recruited through emergency department after initial resuscitation, debridement and bony stabilization if needed. Patients having wounds around distal one third of leg, ankle, dorsum of foot proximal to toes, heel and knee were included. Patients of age group between 5 years and 60 years of either gender were considered. Patients

having peripheral vascular disease and acute wounds around lateral aspect of lower third of leg affecting neurovascular axis were excluded. However, patients having scarring in lower lateral aspect of leg were considered for coverage with reverse sural flap. Demographic data including age and gender, comorbidities, smoking history, etiology of defect, location of defect, flap size (area $\text{cm}^2 = \text{maximum width cm} \times \text{maximum length cm}$) and underlying bony pathology in case of trauma were noted. Modifications performed in cases for harvesting of sural artery flap were also noted. Complications (venous congestion, partial flap necrosis, and complete flap necrosis and flap dehiscence) observed were calculated in terms of percentage. Total duration of operative procedure was noted in terms of minutes from start of incision to complete inset of flap was noted. Percentage of wound healed at 14th post-operative day was also reviewed.

Surgical Technique

After wound care, sural artery flap was designed for coverage of the defect. Pre-operatively, hand held Doppler was used to locate the perforator. Patient was positioned in prone position and under tourniquet control, debridement of the defect with freshening of wound margin was performed. Defect was evaluated and flap was designed accordingly employing various modifications. Various modification executed during study were delaying of reverse artery flap, extended reverse sural artery flap with gastrocnemius muscle cuff, extended reverse sural artery flap along with only mesentery of neurovascular pedicle, exteriorization of the pedicle, islanded reverse sural flap, reverse sural artery flap with skin paddle, nerve sparing reverse sural flap and proximally based sural artery flap. Surgical technique employed was according to the modification used. However, as a standard, neurovascular axis was marked by line joining midpoint of prominent part of lateral malleolus and tendoachilles to the midpoint of popliteal crease. Perforators were located along this line usually at 5cm and 7cm, however, in certain cases of reverse sural artery flap where there was scarring in lower perforator zones, flap was based on proximal perforator at even 10cm and 15 cm along with delaying and extended flap. Depending upon the arc of rotation, pivot point and perforator location, wound template was used to mark the size of flap. Flap dissection started with identification and division of sural nerve and artery and lesser saphenous vein at distal part of flap and must be included within flap harvest. Flap dissection is carried out in

sub fascial plane in standard flap, however, in extended flap; neurovascular pedicle lies deep between two heads of gastrocnemius must be incorporated in the flap either along with mesentery or with 1 cm gastrocnemius muscle cuff. Fascia was sutured to skin flap to avoid shearing forces or detachment of vascular pedicle. As the dissection progressed, musculocutaneous perforators to gastrocnemius muscle and fasciocutaneous perforators of peroneal axis were divided up to the level of pivot point. Pedicle width of at least 4 cm was maintained. Flap was islanded either by tunneling through the subcutaneous tunnel or by exteriorization of pedicle and coverage with skin graft if the tunnel was tight. In certain cases, the reverse sural artery flap was also harvested with skin paddle where the skin paddle was used to cover the defect or where the neurovascular axis in within zone of trauma. In this case, second stage of division and in setting was done after 3 weeks. In cases of delay, second surgery was performed after 10 days after delay procedure, Nerve sparing reverse sural artery flap technique was employed to preserve the sensation of lateral aspect of foot. Proximally based sural artery flap was used to cover defects around knee and proximal one third of leg. Vascularity of flap was assessed after tourniquet release. The flap was inset at the defect site and splintage was done to restrict the movements. Donor area was skin grafted. Patients were advised standard scar therapy. Follow up was done at one month, 3 month and 6 month

Results

A total of 35 cases of lower limb soft tissue defects were dealt with sural artery flap. It included 28 males and 7 females. Mean age of patients is 31.62±13.93 years. Among 30 patients, 5 patients were diabetic, 3 were hypertensive and 6 were smokers. 22 cases presented with bony involvement. Heel area was involved in 7 cases. Defects at lower third of leg were covered in 5 cases. Dorsum of foot was covered in 5 cases. Defects at medial aspect of knee were covered in 3 cases. Ankle was site of defect in 14 cases (Table-1).

Road traffic accident was the most common etiology of these soft tissue defects with 24 cases, followed by diabetic foot in 3 cases, chronic ulcers in 4 cases, tumor in 2 cases and post burn contracture in 2 case (figure 1).

Proximally based sural artery flap was done in 4 cases. Flap was delayed in 15 cases, in which 8 were islanded while 7 were with skin paddle. Distally based reverse sural artery flap was done in 16 cases in which 3 were

nerve sparing, 8 were islanded while 5 were peninsular. A bar chart in figure 2 represents the modifications of sural artery flap.

Table 3: Table Representing Demographic Details, Frequency of Co-morbidities, Bony Involvement and Defect Site

Demographic variable	Frequency (%)
Age (Mean±SD)	31.62±13.93 years
Gender	
Male	28 (80%)
Female	7 (20%)
Comorbidity	
None	21 (60%)
Smoking	6 (17.1%)
Diabetic	5 (14.3%)
Hypertensive	3 (8.6%)
Bony involvement	22 (62.9%)
Site of defect	
Medial aspect of knee	3 (8.6%)
Distal one third of leg	5 (14.3%)
Dorsum of foot	5 (14.3%)
Posterior aspect of heel/ankle	8 (22.9%)
	14 (40%)

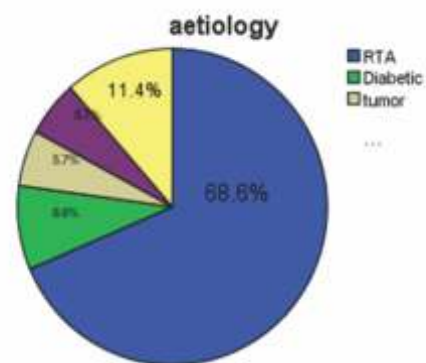


Figure 1:- A Pie Chart Showing Distribution of Aetiology of Lower Limb Defects

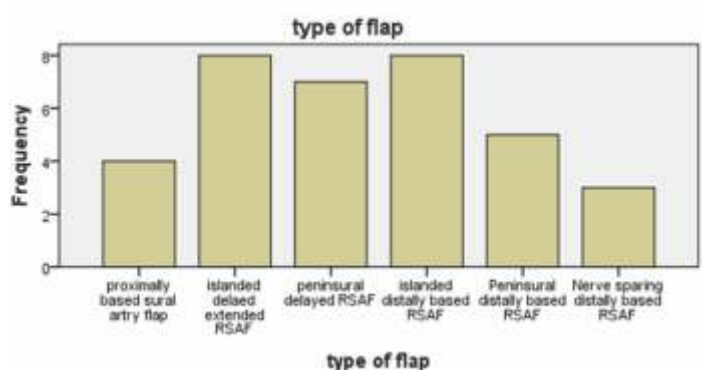


Figure 2:-A Bar chart showing modifications of sural artery flap

Mean flap size was $131.48 \pm 29.46 \text{ cm}^2$. Mean operative time was 79.71 ± 18.78 minutes. Venous congestion was observed in 3 cases which was managed conservatively with elevation and removing stitches. 1 cases showed dehiscence which healed conservatively. Partial flap necrosis was observed in 2 cases. Only distal most parts showed necrosis and that was limited to couple of centimeter strip area. The resulting defects in these cases healed by secondary intention. None of the flap underwent complete flap necrosis. (Table-2)

Table 2: Frequency and Percentage of Patients with Respect to Complications

Outcomes	
Complications (14%)	
Partial Flap Necrosis	2 (5.6%)
Complete flap necrosis	0 (0.0%)
Dehiscence	1 (2.8%)
Venous congestion	2 (5.6%)
Size of flap (cm^2)	$131.48 \pm 29.46 \text{ cm}^2$
Operative time(minutes)	$79.71 \pm 18.78 \text{ min}$
Percentage of wound healing	$97 \% \pm 3$

All data was analyzed using SPSS Version 21. Quantitative data (age, size of flap , operative time) was presented as mean and standard deviation. Qualitative data was presented as percentage and frequency.

Discussion

This study provides significant evidence that the sural artery flap is a safe and a practical option for reconstruction of defects of lower third of leg, knee, ankle and dorsum of foot proximal to toes. The results show various modifications of flap that increases the flap survival and lowers the complication rate.

Road traffic accident is the commonest cause of limb trauma in South Asia.^{4,5} So far is presented in our study that majority of defects (68 %) are due to road side accidents. This also includes spoke wheel injury and degloving injury with exposed extensor tendons. Other causes of defects of lower leg are chronic ulcers, malignancy (melanoma, marjolin ulcer), chronic ulcers, diabetic foot and defects after post burn contracture release are represented in figure 1. Same distribution of etiology is observed in a study by Patil B6.

Although heel defect of small to moderate size is the most commonly treated site with reverse sural artery flap,^{7,8,9} the larger defects around ankle, lower third of leg, dorsum of foot and sole presents true challenge for coverage with this technique. Free flap is considered

as gold standard for such defects. But this study shows employing different modifications can boost its reliability even in case of larger flap and distant defect. Average size of flap harvested in this study is $131.48 \pm 29.46 \text{ cm}^2$. This is closer to average size of flap ($148.10 \pm 59.54 \text{ cm}^2$) mentioned in a series of extended reverse sural artery flap published by Anoop C et al.¹⁰ This result is also in consistent with that noticed in a study by Kneser et al in case of delay of flap¹¹. However, mean flap dimension of classical flap is $8.8 \times 5.6 \text{ cm}$ (49.2 cm^2) mentioned in studies available in literature.¹² So modifying the flap can enhance its vascularity and extension.

Proximal extension of reverse sural artery flap is not predictable in terms of vascularity.^{13,14} For coverage of larger defects, several modifications have been presented in literature to make it more reliable. Extended flap, Delaying of extended flap, pedicle wider than 3 cm, and harvesting of midline gastrocnemius provide longer arc of rotation and larger dimension of flap to cover larger defects at difficult sites.^{15,16} A systemic analysis of modifications of reverse sural artery flap to boost its reliability by Schmidt et al showed favorable results of modifications in terms of complications, however, comparison of different modifications did not yield any significant difference.¹²

In an article by Yousaf M Amin et al, it is mentioned combination of delay and harvest of midline gastrocnemius cuff for islanded extended reverse sural artery flap is mentioned to provide extended coverage with fewer complications.⁵ (In this series, 8 cases were performed in this fashion with only 1 case having partial necrosis. Another trick to cover the large defect of ankle is to harvest the flap as a peninsular flap (flap with cutaneous pedicle). At time of second stage of division and in setting, the skin paddle will provide the tissue coverage of remaining part of the defect. A study by Sheraz M et al discussed the increased reliability of flap with lesser complications by raising with cutaneous pedicle.¹⁷ In this study, five patients having defects of anterior aspect of ankle to the malleolus were covered in this fashion, one representative case is shown in figure 3.

This research highlights the cases where line of lower perforators is within the zone of scarring but extended delayed flap was harvested for coverage based on proximal perforators that were dissected and assessed per-operatively. Figure 4 illustrates the representative case. This is a novel technique to use this flap as an

alternative to free tissue transfer.



Figure 3: Trauma leading to open fracture of proximal metatarsals and ankle joint with soft tissue defect (A) extensive wound on dorsum of foot and ankle of 15×10 cm (B) Delayed extended reverse sural artery flap with skin paddle was used for coverage. (C) In second stage, the skin paddle was used for coverage of lateral part of remaining wound (D) Six month follow



up with future plan of debulking of flap.

Figure 4:- Road traffic accident leading to exposed lateral malleolus along with fracture. (A) There is scarring in area of lower peroneal perforator axis line. Extended reverse sural artery was designed based on a perforator at 15 cm. (B) Isolated Extended reverse sural artery flap harvested with cuff of gastrocnemius muscle (C) 100 % flap survival on 14th postoperative day (D) 6 month follow up



Figure 5 :- (A) Wound on medial aspect of knee of 9×14 cm² with open knee joint and friction burn (B) Isolated proximally based sural artery flap harvested for coverage with rectus femoris tendon repair (C) 100% Flap survival at 14th post operative day (D) 6 month follow up.

Three cases of nerve sparing distally based sural fasciocutaneous flap were performed without any complication and preservation of sensation of lateral aspect of foot. Though the study has been published about the reliability of this flap as Aydin et al, still this entity needs more research¹⁸. Another unique utility of sural artery flap is proximally based sural artery flap for knee defects. Manav P et al performed a retrospective study showing good outcomes of this regional flap as a coverage option.²² Gastrocnemius muscle flap is commonly used option for coverage of knee defects but for larger defects, free tissue transfer is required. However, proximally based fasciocutaneous sural artery flap is a good alternative when the defect is larger and secondary surgery is required for orthopedic intervention. Figure 5 exemplifies the defect treated in this manner.

Several studies showed different complication rate ranging from 5% to 35%.^{13,16,19} Baumeister et al published a data which showed complication rate for partial flap necrosis of 35%.²⁰ In our study, partial flap necrosis is 5.6 % which shows proper planning, execution and post-operative care are also important factors for flap

survival. Complete or near complete flap necrosis is rare as shown in a study by Kneser et al.¹¹ Same result is inferred in this article. Venous congestion is the most common complication (75.3%) encountered¹². Kristoffer B et al discussed in his article that reverse sural artery flap salvage rate had been improved from 50 % to 93% with modification of increasing the pedicle width up to 4 cm or using cutaneous pedicle. This modification reduced the rate of using leech therapy for venous congestion from 42% to 0%.²¹ In this series, we employed the same modification and had only 1 Venous congestion which was managed conservatively. Complication rate has been significantly reduced in last ten years as a result of evolution of various modifications. Overall complication rate in this study is 14%. A systemic analysis by Schmidt K et al proved that modified reverse sural artery flap has statistically significant improvement in complication rate as compared to classical fasciocutaneous flap.¹²

Different factors play role in survival of a large flap which are patient's co morbidities (diabetes, hypertension, peripheral vascular disease), smoking, tight tunnel, inadequate flap design and kinking of pedicle.²³ This study demonstrates proper planning and execution can improve flap survival in spite of having co-morbidities.

In this era of covid-19 infection, less operative time and shorter hospital stay is a blessing to deal with such complex defects. Mean operative time in this analysis is 79.71±18.78 minutes which is significantly shorter than for free tissue transfer. In an analysis performed on free flap reconstruction after lower limb trauma by Alam M et al shows mean operative time of 439±163 minutes which requires more oxygen consumption, greater surgical stress and increased chances of post-operative ICU care.²⁴ In another study by JM Serletti et al, mean operative time for free flap is 7.8 hour which is quite longer.²⁵ In contrast to this, in a study by Anoop C et al, average duration of surgery was 121.29 ±31.6 minutes and average time to raise flap was just 34.2±9.4 minutes consistent with our results.¹⁰ It is observed in this setting of pandemic, where there is need to reserve the resources, this coverage option for technically difficult defects of lower extremity provides an excellent alternative to free tissue transfer.

Although, this flap may need one or more stages to achieve optimum results but still in centers where there is lack of microsurgical expertise and logistics, this modality proves to be a reliable option with low comp-

lication rate. Shorter operative time leads to conservation of resources making sural artery flap a versatile and favorable option in this era of covid-19 infection.

Conclusion

Sural artery flap has always been an excellent choice for reconstruction of defects of lower third of leg of moderate size. However, with modifying this flap, this flap provides coverage of technically difficult, larger defects of lower leg defects. Thus, sural artery flap is an answer for soft tissue coverage of lower limb defects as a reliable alternate to free tissue transfer.

Conflict of interest

None

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Research Article

Extended Pedicle Reverse Sural Artery Flap: A Novel Technique To Reduce Distal Flap Necrosis

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Abstract

Introduction: Standard reverse sural artery flap is a valuable option for reconstruction of soft tissue defects of lower third of leg, hind foot and dorsum of foot, but it is prone to develop venous congestion. We have introduced a novel technique of extended pedicle reverse sural artery flap which has shown better flap survival and outcome.

Methodology: This was a retrospective review of data of patients who underwent standard or extended pedicle reverse sural artery flap for post traumatic wounds of lower leg, ankle, heel and mid foot dorsum, over a period of 6 years (September 2015 to September 2021). Data was retrieved from hospital admission and operation records and case files of the patients for analysis. Outcome variables like flap survival and pattern of necrosis were recorded.

Results: Of the 56 patients who underwent reverse sural artery flap coverage for distal lower extremity, Standard reverse sural artery flap was done in 30(53.6%) and Extended pedicle flap done in 26(46.4%) patients. The mean±SD age of the patients was 15.96±11.3 years. Males accounted for 66.1% (n=37) of patients. Non weight bearing heel was the most common site (n=25, 44.7%), whereas wheel spoke injury was the most common cause(n=33, 58.9%). Mean size of wound was 8.2x6.5 cm for which dimensions of flap elevated were 9x7 cm. Rate of complications was significantly less in extended pedicle reverse sural artery flap (p value 0.037). Flap survival was 25(96.2%) in Extended pedicle reverse sural artery flap group (p value 0.008) with Excellent outcome (p value 0.006).

Conclusion: Extended pedicle reverse sural artery flap is reliable option for coverage of defects around ankle and heel with better flap survival and excellent outcome.

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Keywords | Standard Reverse Sural artery flap, extended pedicle RSAF, Venous congestion, Flap survival.

Introduction

Reverse sural artery flap (RSAF) is one of the common procedures done for the reconstruction of soft tissue defects around ankle and foot.¹ While the standard RSAF is a pedicle flap which brings tissue from posterior leg to fill the defect of foot, there have been a number of modifications described by different authors to achieve better flap survival.²

The most common complication of Standard RSAF is

venous congestion leading to partial or total flap necrosis. Several studies describe different rates up to 36%.³ Various modifications have been suggested in RSAF harvesting technique to prevent venous congestion. These modifications are based on width of the pedicle, dimensions of Skin Island, or improving vascularity of flap as single or two-stage procedure. Some of these modifications have shown promising results with reduced flap necrosis but till now no technique has

been standardized for this flap.

We have devised a new modification in which the pedicle of the flap is extended for 2-3 centimeter above the skin island design. We have found that this maneuver significantly improves the flap survival and markedly enhances the distal flap vascularity. In this study we aim at comparing surgical outcome of extended pedicle reverse sural artery flap (Extended Pedicle RSAF) with standard reverse sural artery flap for reconstruction of foot defects proximal to toes in terms of distal flap necrosis and reliability of technique in our population.

Methods

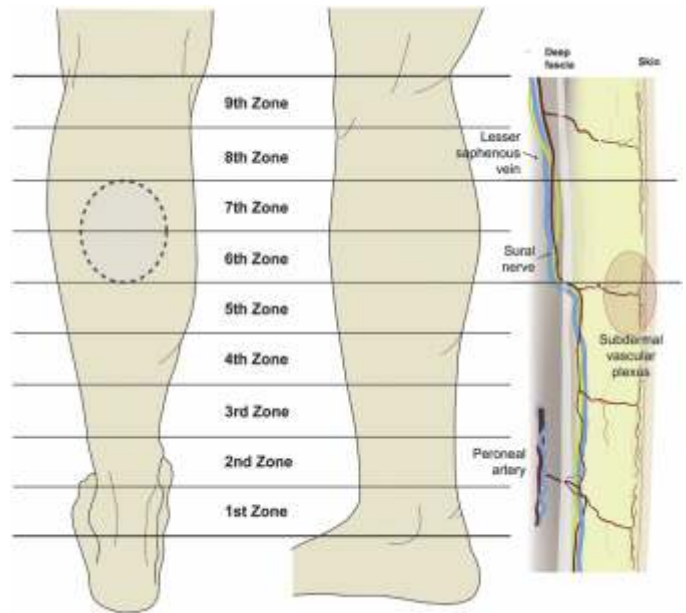
This retrospective comparative study was conducted in Plastic surgery/ Burn unit, Mayo hospital, Lahore. During a period of 6 years from September 2015 to September 2021, all patients between 5 to 50 years of age, who underwent standard or extended pedicle reverse sural artery flap for post traumatic wounds of lower leg, ankle, heel and midfoot dorsum, were included in this study. We excluded patients having wound or scarring on posterior calf, history of smoking, uncontrolled diabetes, and patient with deranged liver function.

After admission, complete history and examination was done and wounds prepared in standard way. Review of pre-operative data from the patients' charts included size and location of wound, degree of involvement of underlying structures, and findings on X-ray such as underlying fracture of tarsal or metatarsal bones. Written informed consent was taken from each patient before starting treatment.

During surgical procedure, adequate debridement was done under tourniquet control and defect geometry evaluated again by senior consultant. Considering the vascular anatomy of the posterior leg according to zones (Figure 1), Standard reverse sural flap raised as an adipo-fasciocutaneous flap from posterior aspect of same leg with patient in prone position. Flap was based distally on 2 suitable perforators (5,7 or 10 cm) proximal to lateral malleolus with axis of flap directed towards an imaginary line which connects midpoint of popliteal fossa to a point midway between lateral malleolus and Achilles tendon. Flap was marked over the middle third of posterior leg as per defect dimension with 1 cm extra for flap contraction and tension free inset.

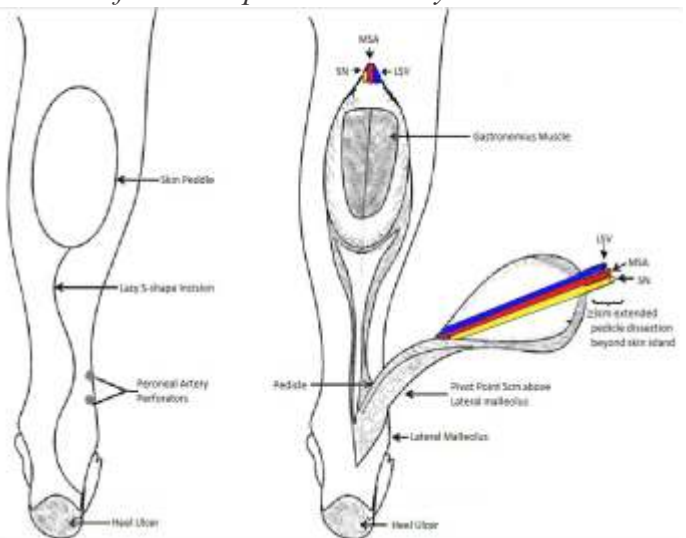
For Extended pedicle sural flap, the pedicle dissection was started in subdermal plane proximal to the standard

skin island. Flap pedicle was elevated at least 3 cm proximal to the proximal limit of marked flap and was loosely tagged while inseting at defect site (Figure 2). Rest of the flap was elevated in standard way and



its perfusion checked after deflating tourniquet.

Figure 1: Illustration of zones in the lower leg and associated anatomy. The posterior and lateral aspects of the leg also depicted with arbitrarily defined zones. Key neurovasculature structures are illustrated along the lower leg (Right). The sural nerve and lesser saphenous vein are depicted in yellow and blue, respectively, and the accompanying arteries in red. The perforating branch from the peroneal artery is shown on the



lower left side⁴.

Figure 2: Illustration of Marking of RSAF and Associated Anatomy

- a) Marking of Standard RSAF
- b) Extended Pedicle RSAF with 3cm Pedicle Extension

in Proximal Posterior Leg

After elevation of flap by both variations, it was transposed and secured in place and raw area of carrier pedicle and donor site was covered with split skin graft. See through dressing was done to check flap survival and splint applied to restrict limb movement.

Post-operatively, operated foot was kept elevated to reduce edema and pain and flap was monitored 6 hourly from dressing window. In all patients first dressing was changed on 2nd day and then on alternate days. Assessment of flap survival in terms of tip epidermolysis or flap necrosis was done by Senior consultant on day 5. Color and capillary refill of flap were main determinants of the flap survival. Patients with uneventful healing of flap were discharged on day 5 while patients having dusky color with rapid capillary refill (signs of venous congestion) were kept in hospital for further management. All patients were followed up after one week of discharge for stitch removal and after 3 weeks, flap was divided and final inseting done.

Data related to patient demographics (age, gender, mode of injury), clinical data (defect site, depth and dimensions), flap dimensions, flap survival (complete, partial or distal tip necrosis) and outcome (excellent, fair, poor) was collected from patients charts and recorded on a proforma.

The collected data was analyzed by SPSS20 statistical software. Descriptive variables were presented by proportions, mean values and percentage as appropriate by data distribution. Quantitative variables like age, size of wound, dimensions of flap and outcome were compared by Chi square test. Qualitative variables like gender, site of wound, complications and flap survival were compared using T-test in both groups; Group A (Standard) & Group B (Extended pedicle). Statistical significance was defined by p-value of <0.05.

Results

A total of 56 patients underwent flap coverage for ankle and foot defects during period of September 2015 to September 2021. Among them, 30(53.6%) patients underwent Standard RSAF and 26 (46.4%) had Extended pedicle RSAF. Mean follow up period after surgery was 38 months (3.2 years) with range of 8-54 months (0.67-4.5 years).

The mean \pm SD age of the patients was 15.96 ± 11.3 years with median age of 13 years. Wheel spoke injury was most common cause for such wounds (n=33,

58.9%). Most of patients belonged to the younger age group of <22 year age (n=39, 69.6%), and were males (n=37, 66.1%). Mean dimensions (length \times width) of the wound at presentation was 8.2x6.5 cm with range of 6.2 \times 5.5 cm to 15 \times 11 cm. 41(73.2%) had exposed tendons, 33(58.9) had exposed bone with or without fracture, and 5 (8.9%) had exposed joint capsule with ligaments. Mean dimensions of flap elevated were 9 \times 7cm with range of 7 \times 6cm to 16 \times 10cm. Comparison of both groups in Age, gender, Anatomical location, cause of wound and size of wound was not statistically significant.

Venous congestion to variable flap extent was most common complication and it was seen commonly in Standard RSAF patients (n=15,50%) as compared to Extended pedicle RSAF showing it only in 1 (3.8%) cases. This difference was found to be statistically significant with a p-value of 0.037. Other complications included wide and hypertrophic scar in 11 (36.7%), wound healing issues 5 (16.6%) and graft loss in 2 (6.7%) in Standard RSAF. Extended pedicle RSAF group showed fairly less complications, with hypertrophic scar seen in 4 (15.3%), wound healing issues 1 (3.8%) and skin graft loss in 1 (3.8%). Table 1 shows further details of all the patients included in this study.

It was observed that flap survival was better in Extended Pedicle flap group as tip epidermolysis was seen in 1 patient only (3.8%). In Standard RSAF group, tip-epidermolysis was seen in 6 (20%), distal tip necrosis in 5(16.7%), partial flap necrosis in 2(6.7%) and complete flap necrosis in 2 patients (6.7%). This difference was found to be statistically significant (p- value 0.008). Epidermolysis was managed conservatively while in distal tip necrosis, debridement followed by flap advancement was done.

Outcome was measured on basis of flap survival. In Standard RSAF group, it was found to be excellent in 15(50%), fair in 11(36.7%) and poor in 4(13.3%) cases. Extended pedicle RSAF group patients showed excellent outcome in 25 (96.2%) and fair in 1 (3.8%) with no poor outcome. Comparison of both groups for outcome was also found to be statistically significant (p-value 0.006).

Discussion

Masquelet described in detail, the anatomy and surgical technique of reverse sural artery flap in 1925. Since then, it is considered a mainstay flap for the reconstruction of soft tissue defects of distal lower extremity

Table 1: Main patient characteristics.

Patient characteristics	Standard RSAF (%)	Extended Pedicle RSAF (%)	Total n(%)	P value
Patient Number	30 (53.6)	26 (46.4)	56 (100)	-
Age				-
5-22 years (n=39)	20 (66.7)	19 (73.1)	39 (69.6)	
23-50 years(n=17)	10 (33.3)	7 (26.9)	17 (30.4)	
Gender				-
Male (n=37)	19 (63.3)	18 (69.2)	37 (66.1)	
Female (n=19)	11 (36.7)	8 (30.8)	19 (33.9)	
Anatomical location				
Non weight bearing heel (n=25)	14 (46.7)	11 (42.3)	25(44.7)	-
Weight bearing heel (n=12)	7 (23.3)	5 (19.2)	12 (21.4)	
Dorsum of foot (n=7)	4 (13.3)	3 (11.5)	7 (12.5)	
Lower leg and ankle (n=12)	5 (16.7)	7 (27)	12 (21.4)	
Clinical data				
Cause of wound	18 (60)	15 (57.7)	33 (58.9)	-
Wheel spoke injury	5 (16.6)	6 (23.1)	11 (19.6)	
Degloving injury	2 (6.7)	1 (3.8)	3 (5.4)	
Post contracture release	3 (10)	3 (11.6)	6 (10.7)	
Post infective	2 (6.7)	1 (3.8)	3 (5.4)	
Post tumor excision				
Size of wound				
< 50 cm ²	21 (70)	19 (73.1)	40 (71.4)	
> 50 cm ²	9 (30)	7 (26.9)	16 (28.6)	-
Structure exposed (Depth)				
Tendons	22 (73.3)	19 (73.1)	41 (73.2)	
Bone	16 (53.3)	17 (65.3)	33 (58.9)	
Joint capsule with ligaments	2 (6.7)	3 (11.5)	5 (8.9)	
Surgery Complications:				
Flap venous congestion	15 (50)	1 (3.8)	16 (28.6)	0.037
Wound healing issues	5 (16.6)	1 (3.8)	6 (10.7)	
Skin Graft loss	2 (6.7)	1 (3.8)	3 (5.4)	
Wide & Hypertrophic scar	11 (36.7)	4 (15.3)	15 (26.7)	
Flap Survival:				
Tip Epidermolysis	6 (20)	1 (3.8)	7 (12.5)	0.008
Distal tip necrosis (<25%)	5 (16.7)	---	6 (10.7)	
Partial flap necrosis (<50%)	2 (6.7)	---	2 (3.6)	
Complete flap necrosis (100%)	2 (6.7)	---	2 (3.6)	
Outcome:				
Excellent (no flap necrosis)	15 (50)	25 (96.2)	40 (71.4)	
Fair (<1cm flap necrosis)	11 (36.7)	1 (3.8)	12 (21.4)	0.006
Poor (> 1 cm flap necrosis)	4 (13.3)	---	4 (7.1)	

and hind foot. With improvement in anatomical knowledge and surgical skills, many technical modifications have been suggested to improve viability of this flap.^{6,7}

In this observational study, it was found that in both standard and extended pedicle RSAF groups, males (66.1%) are more likely to have foot trauma, and spoke wheel injury is the most common cause, followed by degloving injury due to RTA. These findings are similar to various studies.^{8,9,10} Most common anatomical site of the wound on foot found in our patients was non-weight bearing heel (44.7%) followed by weight bearing heel (21.4%) and it was similar to that seen in another

study.³ Mean defect size in our cases was 53.3 cm² which was comparable to other studies.¹¹

Several modifications have been discussed to be considered while elevating standard RSAF in order to increase flap viability including elevating deep fascia and fat, taking short saphenous vein and sural nerve with flap, flap delay, taking cuff of gastrocnemius muscle around the pedicle and protecting collaterals of peroneal artery by taking a wide pedicle.^{11,12} All these variations have variable flap survival in different centers and still venous congestion in distal flap leading to flap necrosis is most common complication related to Standard RSAF (50%

in our study). In order to solve this problem, we suggested a modification in which dissection of the flap pedicle is extended proximally up to 3cm, saving the oblique cutaneous branches. This led to minimize the venous congestion to 3.8 % in extended pedicle RSAF. Rest of the surgery related complications like wound healing issues, skin graft loss and wide hypertrophic scar were comparable to other studies.¹³

In our study, Standard RSAF had flap survival issues in 50% of cases in terms of tip epidermolysis, distal tip necrosis, partial flap necrosis and complete flap loss. Various studies show comparable flap survival issues in Standard RSAF.¹⁴ Extended pedicle RSAF modification showed good flap survival with only 1 (3.8%) case having tip epidermolysis which was managed conservatively. Also outcome was found to be Excellent in Extended pedicle RSAF group with 96.2% success rate and Fair in only 3.8 cases. However Standard RSAF group had excellent outcome in 50% of cases, Fair in 36.7% and Poor outcome in 13.3% cases which is comparable to other studies.¹⁵

Our study has certain strength and limitations. Strengths of our study are that it gives detailed analysis on demographical, clinical, and outcome data with respect to Standard and Extended pedicle RSAF. It also gives thorough information about surgical approach to both techniques. Also, high quality outcome data in terms of flap survival and overall outcome is measured. The main limitation of our study is that it is a retrospective cohort from a single center leading to more chances of selection bias. Patient number was also small and results were based on relatively short follow-up period.

Conclusion

Our modification of extended pedicle RSAF proved efficacious in minimizing venous congestion and hence flap necrosis. Compared with Standard RSAF, our method yielded higher flap survival rate. This novel approach can lead to reconstruction of hind foot defects with significantly reduced incidence of flap loss.

Conflict of Interest

None

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Case Report

Squamous Cell Carcinoma Arising in Hidradenitis Suppurativa, a Rare but Dreadful Complication

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Abstract |

Squamous cell carcinoma (SCC) arising in the setting of long standing hidradenitis suppurativa (HS) is a rare consequence with a high morbidity and mortality. It can often remain unrecognized and delayed diagnosis can lead to advanced stage at presentation and thus a poor outcome. We present a case of HS involving bilateral axillae, groin and natal cleft, for the past five years. The diseased tissue in the natal cleft transformed to SCC. The patient had a stormy course with multiple complications. It was a moderately differentiated tumor with such an aggressive disease course that within a period of five months the patient lost the battle. We suggest a high index of suspicion in long standing HS cases. Early diagnosis, detailed metastatic workup, wide excision, sentinel lymph node biopsy and adjuvant radiation therapy can decrease the morbidity and mortality.

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Keywords | Hidradenitis suppurativa, Squamous Cell Carcinoma, Verneuil's Disease

Introduction

Squamous Cell Carcinoma (SCC) is the most dreadful complication of hidradenitis suppurativa (HS) of perineal and gluteal areas.¹ Chronic relapsing and remitting nature of the disease superimposed with lymphedema plays a pivotal role in metastatic transformation into SCC in long standing HS.² We hereby present a case of HS complicated by metastatic transformation into SCC.

Case Presentation

A thirty-eight year old Pakistani male, driver by profession for the past 12 years, presented with a history of hidradenitis suppurativa of both axillae, both groin and natal cleft for past 5 years. He was managed conservatively for most of the areas, except for right axilla for which he underwent surgical excision and coverage with split thickness skin graft in 2018. He presented with Hurley's grade III HS of the natal cleft (Figure 1a & b). Physical examination showed an area of about

16×18 cm, with irregular margins and multiple discharging sinuses and cysts, spanning cranially from the level of sacrum into the natal cleft till the level of coccyx bone caudally, with loss of soft tissue in central area of 8×7cm. Incisional biopsy was performed along with contrast enhanced MRI Scan of the abdomen and pelvis. MRI revealed disease extending from S1 level to the tip of coccyx bone. Multiple linear sinus tracts extending from skin to the natal cleft also involving the gluteus maximus muscles. No coccygeal or sacral osteomyelitis was seen. The biopsy revealed non keratinizing moderately differentiated squamous cell carcinoma. After performing the baseline and metastatic workup, case was discussed in multi-disciplinary team (MDT) meeting. On 22nd July, 2020, resection was performed by the Oncological surgeon with 2cm margin of clearance from the palpable margins of tumor under frozen section control. The deep margin from above the coccyx came out to be positive and additional clearance with negative margin was performed. A defect of about 25×25cm

was created and was reconstructed by plastic surgery team using left inferior gluteal artery rotation advancement flap (Figure 2 a & b).

On consensus of MDT, patient was put on adjuvant radiotherapy; he received 08 fractions of radiotherapy which were completed on 30th September, 2020. His radiation therapy was complicated by wound breakdown and multiple sinuses which were debrided and managed with VAC therapy. On the 5th of October 2020, he presented to the emergency department with swollen and tender right lower quadrant of the abdomen and foul smelling dirty colored discharge from right groin. On investigations he was found to have an extremely low Hb level of 4.9g/dl. The findings on CECT abdomen and pelvis were consistent with the features of necrotizing fasciitis and also showed a mass in the right sacral region of size 48×37mm inseparable from the sacral bone and causing bone erosion. The scan also showed multiple enlarged and necrotic bilateral inguinal and pelvic lymph nodes. Patient underwent aggressive debridement and multiple blood transfusions to build up the Hemoglobin level. He was started on palliative chemotherapy, 1st cycle was given on 27th Oct, 2020. Unfortunately the patient experienced a fatal episode of hemorrhage from femoral artery blow-out and expired on 1st Nov, 2020.

Discussion:

Hidradenitis suppurativa is a chronic inflammatory disorder of the pilosebaceous units of the skin with a prevalence of 1% in European population and 0.05% to 0.20% in American population.³ There is lack of literature about the prevalence of this disease in our part of the world. With a penetrance of 100% this autosomal dominant disease has a variable phenotypic expression.^{4,5} The complications associated with this disease range from hyperpigmentation, scarring, fibrosis, lymphatic obstruction, paraneoplastic syndrome and the most dreadful being SCC.⁶ The relapsing disease with its associated complications not only affects the patient physically, psychologically and socially but may also cost the patient his life.^{1,3} Over 80 cases of HS have been reported to develop SCC, with the average age at presentation being 52.4 years and the mean duration of HS prior to development of SCC being 25years.⁷ This disease predominantly affects women, but, there is a male preponderance in SCC transformation.^{1,8} Various factors have been postulated to contribute to the process of malignant transformation, with chronic inflammation and epider-

mal hyperplasia being on top of the list.¹ The chronic lymph stasis in HS disturbs the circulation of immunocompetent cells to the area thus making that tissue immunocompromised and thus prone to malignancy.² The predominance of SCC in perineal, perianal and gluteal areas is possibly linked to the presence of bacteria and viruses in these regions. The presence of HPV is one of the established risk factor in ano-genital squamous cell carcinomas.⁸ The use of anti-TNF alpha therapy in the management of HS has been reported to contribute to rapid transformation to SCC.^{1,8} Smoking also increases the susceptibility of these patients to SCC.⁸ Any unexplained neuropathy on background of HS, should alert the clinicians to look for SCC.⁷

Conclusion

In the context of high associated mortality with reported death rate of above 40%⁹ with more than 57% of patients dying within the first two years,¹ there should be a high index of suspicion for SCC in underlying HS. Prompt histological diagnosis, metastatic workup using MRI/ PET scan, surgical excision with a minimum of 2cm margins, sentinel lymph node biopsy to rule out occult lymph node metastasis and adjuvant radiation therapy, should all be incorporated as practice guidelines to decrease the associated morbidity and mortality.



Figure 1 A; Extent of the Lesion, b; Resected Specimen



Figure 2: A; Defect Size, B; Soft Tissue Coverage with Left Inferior Gluteal Artery Rotation Advancement Flap

Conflict of Interest

None

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Case Report

Surgical Management of Giant Scrotal Lymphedema – A Case Report

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Abstract |

Giant scrotal lymphedema (GSL) causes marked physical distress, and has severe cosmetic and psychosocioeconomic consequences, decreasing the quality of life of the sufferer. Excision is often required as medical treatment is insufficient to produce acceptable results. We report surgical management of a case of idiopathic giant scrotal lymphedema. Involved tissue was excised maximally. There was a significant improvement in walking, sitting and squatting, and patient was able to perform his daily activities in a much better way. At one year follow-up there was recurrence, for which further debulking was performed. Patient was satisfied with cosmetic outlook and his physical as well as psychological distress was significantly decreased.

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Introduction

Giant scrotal lymphedema (GSL), also called scrotal elephantiasis is a rare condition characterized by massive scrotal enlargement with genital deformation. GSL is caused by inadequate lymphatic drainage due to aplasia, hypoplasia or obstruction of lymphatic vessels. This leads to accumulation of interstitial fluid in scrotal subcutaneous tissue. GSL not only causes physical distress but also has cosmetic and severe psychosocioeconomic consequences, decreasing the self esteem and quality of life of the sufferer. Excision is often required as medical treatment is insufficient to produce acceptable results.^{1,2,3}

We report successful surgical management of a case of idiopathic giant scrotal lymphedema with no history of filariasis, malignancy, surgery or radiation.

Case Report

Forty-year-old unmarried male presented with progressively increasing swelling of scrotum, right lower limb and left thigh for the past 20 years. Swelling was associated with itching, difficulties in maintaining

hygiene and recurrent skin infections with purulent discharge from the involved areas. Massive scrotal enlargement also caused heaviness, pain, difficulty in walking, sitting, squatting and urinating. Patient underwent drainage of recurrent abscesses multiple times. He had severe psychological distress due to inability to perform activities of daily living, foul odour and heavy expense of treatment.

Physical examination showed a massively enlarged scrotum extending down to knee-level. Penis was not visible and completely buried in the lymphedematous scrotal tissue. The scrotal skin was very thick, non-pitting and rugated, with multiple excoriations, pits and scar marks visible. It was not possible to palpate testes through the tough scrotal skin. The scrotal mass measured 30×32×34 cm (Figure 1 A, B & C). Inguinal lymph nodes were not palpable. Patient's gait was also disturbed.

Laboratory investigations were within normal limits and blood smear for microfilariae was negative. Abdominal and scrotal sonography revealed bilateral atrophic

testes. The patient was counseled and informed consent was taken before proceeding with surgery.



Figure 1. A,B& C: pre-operative appearance of scrotal mass; D & E: excised specimen; F: post excision wound with visible testes; G, H & I: immediate post-operative appearance



Figure 2: Same patient at 1 year follow-up showing recurrence of swelling (A & B), and after second debulking (C & D)

Surgical debulking of lymphomatous scrotal tissue was performed under general anesthesia. Patient was placed in lithotomy position and was catheterized. Skin incisions were marked and tumescent solution (1% lidocaine and 1:1000,000 epinephrine) was infiltrated. Involved tissue was excised maximally. Penis was

exposed all around and penile skin was found to be normal. Contrary to ultrasound finding both testes were also found normal in shape and texture (Figure 1F). Testes were repositioned and neo-scrotum was created with remaining spared posterolateral skin over a suction drain (Figure 1 G, H & I). Excised specimen weighing 16kg was sent for histopathology (Figure 1 D & E). Catheter and suction drain was removed on 7th post-operative day. The patient was discharged with scrotal support and also advised to wear tight compression garments.

Histopathology report showed nonspecific chronic inflammation with dilated lymphatic vessels, epidermal thickening and dermal fibrosis.

No postoperative hematoma, infection, necrosis or wound dehiscence was observed. Pain and dull aches were markedly reduced. There was a significant improvement in walking, sitting and squatting and he was able to perform his work in much better way. At one year follow-up there was recurrence, for which further debulking was performed (Figure 2).

Discussion:

We found that surgical debulking for giant scrotal lymphoedema (GSL) is very rewarding. The patient reported marked psychological relief, and was satisfied with functional and cosmetic outcome. The procedure improved his quality of life.

Genital lymphedema is a rare condition and is classified as congenital (primary) and acquired (secondary). Primary lymphoedema is further classified into congenital hereditary lymphoedema, lymphoedemaprecox and lymphoedema tarda based on the age of onset in infancy, childhood and adulthood respectively. Most common cause of Secondary lymphoedema is filariasis, however it can also result secondary to radiotherapy, surgery, malignancy or trauma.^{3,4,5}

Shusruta was thought to be the first surgeon who performed excision in genital lymphedema at around 600 BC.³ Some surgeons reported serial debulking of lymphomatous scrotal subcutaneous tissue, however other surgeons preferred near total excision of abnormal tissue.^{2,3} Similarly different surgical techniques were described for coverage of exposed testicles after resection including skin grafting or reconstruction of neo-scrotum with anterior, posterior or posterolaterally based remaining scrotal skinflaps or regional pedicled flaps from thigh.⁶ Historically some surgeons reported burying testis in pouch made in thigh. Jones et al found

that higher temperature resulting from pedicled flaps from thigh for neoscrotum reconstruction led to disturbed spermatogenesis and used remaining posterior scrotal skin for coverage of the exposed testicles.^{6,7,8}

We strengthen that excision is mainstay of treatment of GSL. In this case our aim was to decrease the physical distress of the patient, so maximum debulking was performed with preservation of testis and the cord. As described in few other studies, studies we also used posterolateral skin for neoscrotal reconstruction as it was relatively spared.^{8,9} The purpose of making neoscrotum with posterolateral skin was to provide natural tissue for cover, which will maintain normal testicular function and also provide better cosmesis. Minor complications such as wound infection, dehiscence and delayed wound healing were mentioned in literature however in this case we did not encounter any complication.¹² We observed poor postoperative patient compliance for non-surgical adjunctive measures (massage, elevation and compression garments) and that might be a reason for recurrence seen at one year follow-up.

Our Patient was satisfied with cosmetic outlook and his physical as well as psychological distress was significantly reduced. He no longer has recurrent scrotal skin infections. He was able to return to work and has become a useful member of his family. He is also planning for marriage.

In our opinion properly planned surgical debulking should be performed for this incapacitating condition and making neoscrotum with relatively spared posterolateral skin maintains testicular function with pleasing cosmesis.

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Editorial

The Soul of Plastic Surgery

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Editor-in-Chief

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As plastic surgeons we justifiably pride ourselves on our long and rich history of surgical innovation and the ability to solve hitherto insurmountable problems. We can reliably trace the lineage of our profession to 600 BC, to the time of Susruta and the first forehead flap used in nasal reconstruction¹.

Some Progress was seen during the times of the ancient Grecian and Roman civilisations. Perhaps the most notable is *De Medicina* by Roman writer Aulus Cornelius Celsus in which techniques for reconstruction of the nose, lips, and ears are described¹. In the Byzantine era, Oribasius put together an exhaustive 70 volume medical text called the *Synagoge Medicae* which contained several sections dedicated to the repair of facial defects.

The Renaissance in its wake brought remarkable advances in all the sciences. In the fifteenth-century, the Ottoman surgeon Serafeddin Sabuncuoglu wrote a surgical tome titled 'Imperial surgery' which included 153 surgical topics, including detailed descriptions of maxillofacial surgery, eyelid reconstruction and gynaecomastia.

Despite these noteworthy developments, it was the great wars of the twentieth century which were to have the greatest impact on the progress of our specialty. Military surgeons were faced with a plethora of extensive facial injuries the likes of which had rarely been encountered. These devastating injuries required courageous new innovations in reconstructive surgical techniques, thus giving birth to modern Plastic Surgery².

By the middle of the last century Plastic Surgery as we know it had really come into its own.

As we reflect upon the remarkable advances made by our specialty, one is also compelled to recognize the changes within our specialty. Aesthetic work now forms a significantly larger proportion of the repertoire of Plastic surgeons in the developed world.

This in itself is neither surprising nor necessarily retrogressive. There is increasing demand for cosmetic procedures and the financial incentives are significant. I strongly believe that our aesthetic work makes us better at the reconstructive part of our practice and vice versa. The worrying thing is that more and more of the young plastic surgeons coming out of our training programs are devoting themselves purely to cosmetic work. The grey line between dermatological aesthetics and plastic surgery is getting even more blurred giving rise to the genre of the 'Cosmetologist'³. These individuals can be from any branch of medicine or even enterprising general practitioners who may or may not have had any formal training.

Our specialty is the only one which is not based on an anatomical region or an organ system. Our only claim to being an independent specialty has always been that 'we can do it better'. This claim is based on a profound understanding of the minutiae of anatomy and the technical finesse and innovative ethos that is the hallmark of a plastic surgeon. This, however, is not enough. We have to be doing more of a particular procedure to appreciate the nuances of technique that will enable us to live up to our promise. Whether we acknowledge it or not, our specialty has always faced an existential threat as we do not have the protection of an exclusive anatomical region. In many countries in the west we have already lost ground to regional specialists. Head and neck reconstruction after cancer ablation has traditionally been a purely plastic surgical area of endeavor. We have made landmark contributions to this field and yet in the United States more ENT surgeons are leading the charge rather than plastic surgeons. In the U.K, it is the Maxillofacial surgeons who are the go-to specialists for this in a significant number of units⁴. It is the same story in hand surgery, Hypospadias repair and cleft lip and

palate. The emergence of Facial Plastic Surgery and Breast surgery as established fields is further eroding into the diminishing province of Plastic surgery. Not being rooted to a region, we were always a surgical anomaly and if we are not careful, we will stand corrected. That would be a sad day for surgeons whom Millard described as 'the most highly skilled individuals on the planet'. We simply cannot afford to 'de- skill' ourselves to fit into the mold of a Cosmetologist, or we risk losing the soul of the identity that makes us unique.

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(Base upon Minimum Requirements for Writing and Editing of Manuscripts)

Introduction

The new Editorial Board of Pakistan Journal of Plastic Surgery during its meeting held on January, 2019 decided to follow the “Uniform requirements for manuscripts submitted to Biomedical Journals: writing & Editing for Biomedical Publications by International Committee of Medical Journal Editors. A brief account of minimum requirements is given below for assisting the authors, reviewers and editors, the full text can be read, (www.icmje.org). Moreover plagiarism policy of ICMJE, Higher Education Commission and PMDC will be observed. It is authors' responsibility to apprise them of plagiarism in any form including paraphrasing and self plagiarism. The Plagiarism Standing Committee of Pakistan Journal of Plastic surgery would deal with cases of plagiarism and comprise of staff members, and editors. Those claiming intellectual/ idea or data theft of an article must provide documentary proof in their claim otherwise their case will be sent for disciplinary action.

General Principles

1. Title Page

The title page should carry the following information:

1. The title of the article. Concise titles are easier to read than long, convoluted ones. Authors should include all information in the title that will make electronic retrieval of the article both sensitive and specific.
2. Authors' names and Title of the Program. The names and other relevant information should be on title page only to ensure blind peer review of research article.
3. The name of the department(s) and institution(s) to which the work should be attributed.
4. Disclaimers, if any.
5. Corresponding authors. The name, mailing address, telephone and fax numbers, and e-mail address of the author responsible for correspondence about the manuscript.
6. Source(s) of support in the form of grants, equipment, drugs, or all of these.
7. Word counts. A word count for the text only (excluding abstract, acknowledgments, figure legends, and references). A separate word count for the Abstract is also useful for the same reason.

8. The number of figures and tables.

9. Conflict of Interest Notification Page

2. Conflict of Interest Notification Page

To prevent the information on potential conflict of interest for authors from being overlooked or misplaced, it is necessary for that information to be part of the manuscript. It should therefore also be included on a separate page or pages immediately following the title page.

3. Abstract and Key Words

An abstract (requirements for length and structured format vary by journal) should follow the title page. The abstract should provide the context or background for the study and should state the study's purposes, basic procedures (selection of study subjects or laboratory animals, observational and analytical methods), main findings (giving specific effect sizes and their statistical significance, if possible), and principal conclusions. It should emphasize new and important aspects of the study or observations.

Authors are requested to provide, and identify as such, 3 to 10 key words or short phrases that capture the main topics of the article. These will assist indexers in cross-indexing the article and may be published with the abstract. Terms from the Medical Subject Headings (MeSH) list of Index Medicus should be used.

4. Introduction

Provide a context or background for the study (i.e., the nature of the problem and its significance). State the specific purpose or research objective of, or hypothesis tested by, the study or observation; the research objective is often more sharply focused when stated as a question. Both the main and secondary objectives should be made clear, and any pre-specified subgroup analyses should be described. Give only strictly pertinent references and do not include data or conclusions from the work being reported.

5. Material and Methods

The Methods section should include only information that was available at the time the plan or protocol for the study was written; all information obtained during the conduct of the study belongs in the Results section.

(a) Selection and Description of Participants

Describe your selection of the observational or

experimental participants (patients or laboratory animals, including controls) clearly, including eligibility and exclusion criteria and a description of the source population. The guiding principle should be clarity about how and why a study was done in a particular way. When authors use variables such as race or ethnicity, they should define how they measured the variables and justify their relevance.

(b) Technical Information

Identify the methods, apparatus (give the manufacturer's name and address in parentheses), and procedures in sufficient detail to allow other workers to reproduce the results. Give references to established methods, including statistical methods (see below); provide references and brief descriptions for methods that have been published but are not well known; describe new or substantially modified methods, give reasons for using them, and evaluate their limitations. Identify precisely all drugs and chemicals used, including generic name(s), dose(s), and route(s) of administration. Also describe diagnostic or therapeutic procedures if part of the study design.

(c) Statistics

Describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to verify the reported results. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Define statistical terms, abbreviations, and most symbols. Specify the computer software used.

6. Results

Present your results in logical sequence in the text, tables, and illustrations, giving the main or most important findings first. Do not repeat in the text all the data in the tables or illustrations; emphasize or summarize only important observations.

When data are summarized in the Results section, give numeric results not only as derivatives (for example, percentages) but also as the absolute numbers from which the derivatives were calculated, and specify the statistical methods used to analyze them. Restrict tables and figures to those needed to explain the argument of the paper and to assess its support. Use graphs as an alternative to tables with many entries; do not duplicate data in graphs and tables.

7. Discussion

Emphasize the new and important aspects of the study and the conclusions that follow from them. Do not

repeat in detail data or other material given in the Introduction or the Results section. For experimental studies it is useful to begin the discussion by summarizing briefly the main findings, then explore possible mechanisms or explanations for these findings, compare and contrast the results with other relevant studies, state the limitations of the study, and explore the implications of the findings for future research and for clinical practice.

Link the conclusions with the goals of the study but avoid unqualified statements and conclusions not adequately supported by the data. Avoid claiming priority and alluding to work that has not been completed. State new hypotheses when warranted.

8. References

(a) General Considerations Related to References

Although references to review articles can be an efficient way of guiding readers to a body of literature, review articles do not always reflect original work accurately. Small numbers of references to key original papers will often serve.

Avoid using abstracts as references. References to papers accepted but not yet published should be designated as "in press" authors should obtain written permission to cite such papers as well as verification that they have been accepted for publication. Information from manuscripts submitted but not accepted should be cited in the text as "unpublished observations" with written permission from the source.

Avoid citing a "personal communication" unless it provides essential information not available from a public source, in which case the name of the person and date of communication should be cited in parentheses in the text. For scientific articles, authors should obtain written permission and confirmation of accuracy from the source of a personal communication.

For articles published in journals indexed in MEDLINE, the Pakistan Journal of Plastic Surgery considers PubMed (<http://www.pubmed.gov>) the authoritative source for information about retractions.

(b) Reference Style and Format

The Uniform Requirements style is based largely on an ANSI standard style adapted by the National Library of Medicine (NLM) for its databases. For samples of reference citation formats, authors should consult National Library of Medicine web site.

References should be numbered consecutively in the order in which they are first mentioned in the text. Identify references in text, tables, and legends by Arabic numerals in parentheses. The titles of journals should be abbreviated according to the style used in Index Medicus. Consult the list of Journals Indexed for MEDLINE, published annually as a separate publication by the National Library of Medicine.

9. Tables

Tables capture information concisely, and display it efficiently; they also provide information at any desired level of detail and precision. Including data in tables rather than text frequently makes it possible to reduce the length of the text.

Type or print each table with double spacing on a separate sheet of paper. Number tables consecutively in the order of their first citation in the text and supply a brief title for each. Do not use internal horizontal or vertical lines. Give each column a short or abbreviated heading. Authors should place explanatory matter in footnotes, not in the heading. Be sure that each table is cited in the text.

10. Illustrations (Figures)

Figures should be either professionally drawn and photo-graphed, or submitted as photographic quality digital prints. In addition to requiring a version of the figures suitable for printing, Pakistan Journal of Plastic Surgery ask authors for electronic files of figures in a format (e.g., JPEG or GIF) that will produce high quality images in the web version of the journal; authors should review the images.

For x-ray films, scans, and other diagnostic images, as well as pictures of pathology specimens or photomicrographs, send sharp, glossy, black-and-white or color photo-graphic prints, usually 127 x 173 mm (5 x 7 inches). Letters, numbers, and symbols on Figures should therefore be clear and even throughout, and of sufficient size that when reduced for publication each item will still be legible. Figures should be made as self-explanatory as possible, since many will be used directly in slide presentations. Titles and de-tailed explanations belong in the legends, however, not on the illustrations themselves.

Photomicrographs should have internal scale markers. Symbols, arrows, or letters used in photomicrographs should contrast with the background.

If photographs of people are used, either the subjects must not be identifiable or their pictures must be accompanied by written permission to use the photograph. When-ever possible permission for

publication should be obtained.

Figures should be numbered consecutively according to the order in which they have been first cited in the text.

11. Legends for Illustrations (Figures)

Type or print out legends for illustrations using double spacing, starting on a separate page, with Arabic numerals corresponding to the illustrations. When symbols, arrows, numbers, or letters are used to identify parts of the illustrations, identify and explain each one clearly in the legend.

12. Units of Measurement

Measurements of length, height, weight, and volume should be reported in metric units (meter, kilogram, or liter) or their decimal multiples.

Temperatures should be in degrees Celsius. Blood pressures should be in millimeters of mercury, unless other units are specifically required.

13. Abbreviations and Symbols

Use only standard abbreviations; the use of non-standard abbreviations can be extremely confusing to readers. Avoid abbreviations in the title. The full term for which

14. Drug Name

Generic names should be used. When proprietary brands are used in research, include the brand name and the name of the manufacturer in parentheses after first mentioning of the generic name in the Methods section.

15. Guidelines for Authors and Reviewers

All material submitted for publication should be sent exclusively to the Pakistan Journal of Plastic Surgery. Work that has already been reported in a published paper or is described in a paper sent or accepted elsewhere for publication, should not be submitted. Multiple or duplicate submission of the same work to other journal should be avoided as this fall into the category of publication fraud and are liable for disciplinary consequences, including reporting to Pakistan Medical & Dental Council and Higher Education Commission. A complete report following publication of a preliminary report, usually in the form of an abstract, or a paper that has been presented at a scientific meeting, if not published in full in a proceedings or similar publication, may be submitted. Press reports of meetings will not be considered as breach of this rule, but additional data or copies of tables and illustrations should not amplify such reports. In case of doubt, a copy of the published material should be included with a

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The editors reserve the right to edit the accepted article to conform to the house-style of the Journal.

16. General archival and linguistic instructions

Authors should submit the manuscript typed in MS Word. Manuscripts should be written in English in British or American style/format (same style should be followed throughout the whole text), in past tense and third person form of address. Sentences should not start with a number or figure. Any illustrations or photographs should also be sent in duplicate. Components of manuscript should be in the following sequence: a title page (containing names of authors, their postal and Email addresses, fax and phone numbers, including mobile phone number of the corresponding author), abstract, key words, text, references, tables (each table, complete with title and footnotes) and legends for illustrations and photographs. Each component should begin on a new page. The manuscript should be typed in double spacing as a single column on A4 (8-1/2" x 11" or 21.5 cm x 28.0 cm), white bond paper with one inch (2.5 cm) margin on one side.

Sub-headings should not be used in any section of the script except in the abstract. In survey and other studies, comments in verbatim should not be stated from a participating group. Acknowledgements are only printed for financing of a study or for acknowledging a previous linked work.

From January 2016, all randomized trials should also provide a proof of being registered at the

International RCT Registry.

17. Material for Publication

The material submitted for publication may be in the form of an Original research (Randomized controlled trial - RCT, Meta-analysis of RCT, Quasi experimental study, Case Control study, Cohort study, Observational Study with statistical support etc), a Review Article, Commentary, a Case Report, Recent Advances, New techniques, Debates, Adverse Drug Reports, Current Practices, Clinical Practice Article, Short Article, KAP (Knowledge, Attitudes, Practices) study, An Audit Report, Evidence Based Report, Short Communication or a Letter to the Editor. Ideas and Innovations can be reported as changes made by the authors to an existing technique or development of a new technique or instrument. A mere description of a technique without any practical experience or innovation will be considered as an update and not an original article. Any study ending three years prior to date of submission is judged by Editorial Board for its suitability as many changes take place over the period of time, subject to area of the study. Studies more than three years old are not entertained. In exceptional cases, if Editorial Board is of the view that data is important, an extension of one year may be granted. Pakistan Journal of Plastic Surgery also does not accept multiple studies/multiple end publications gathered/derived from a single research project or data (wholly or in part) known as 'salami slices'.

Original articles should normally report original research of relevance to clinical medicine. The original paper should be of about 2000-2500 words excluding abstract and references. It should contain a structured abstract of about 250 words. Three to 10 keywords should be given for an original article as per MeSH (Medical Subject Headings). There should be no more than three tables or illustrations. The data should be supported with 20 to 25 references, which should include local as well as international references. Most of the references should be from last five years from the date of submission.

Clinical Practice Article is a category under which all simple observational case series are entertained. The length of such article should be around 1500 - 1600 words with 15 - 20 references. The rest of the format should be that of an original article. KAP studies, Audit reports, Current Practices, Survey reports and Short Articles are also written on the format of Clinical Practice Article. Evidence based reports must have at least 10 cases and word count of 1000 - 1200 words with 10 - 12 references and not more than

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Review article should consist of critical overview/analysis of some relatively narrow topic providing background and the recent development with the reference of original literature. It should incorporate author's original work on the same subject. The length of the review article should be of 2500 to 3000 words with minimum of 40 and maximum of 60 references. It should have non-structured abstract of 150 words with minimum 3 key words. An author can write a review article only if he/she has written a minimum of three original research articles and some case reports on the same topic.

Letters should normally not exceed 400 words, with not more than 5 references and be signed by all the authors-maximum 3 are allowed. Preference is given to those that take up points made in contributions published recently in the journal. Letters may be published with a response from the author of the article being discussed. Discussions beyond the initial letter and response will not be entertained for publication. Letters to the editor may be sent for peer review if they report a scientific data. Editorials are written upon invitation.

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