RESEARCH
O&G Forum 2024; 34-3s: 1085-1089

Lower Trapezius Transfer Technique for Rotator Cuff Tear: Insights from General Surgery

Dr Kanak Hebbalkar (Junior Resident)[1], Dr. Nitin Nangare (Professor)[2], Dr Anuroop Bhakkad(Junior Resident)[3]
Department of General Surgery, Krishna Institute Medical Sciences,KVV,karad.
Corresponding Author-
Dr Kanak Hebbalkar (Junior Resident), Department of General Surgery, Krishna Institute Medical Sciences, KVV, karad

Abstract
The current study presents a surgical innovation in the realm of general surgery, focusing on the utilization of hamstring tendon autograft (specifically semitendinosus and gracilis) as an adjunct in the transfer of the lower trapezius for addressing massive or irreparable rotator cuff tears. This technique offers a theoretical advantage by providing a larger footprint area on the greater tuberosity of the humerus, aligning more closely with the native anatomy. The procedure involves attaching the hamstring tendon autograft to the lower trapezius through a 4cm incision along the middle third of the scapular spine. Subsequently, the tendon is transferred to the infraspinatus footprint on the greater tuberosity of the humerus via a second incision beneath the lateral acromial margin. Patients underwent preoperative assessments and were followed up after 6 months post-surgery. Results indicated significant improvements across various parameters: pain levels, as measured by the Visual Analogue Scale, decreased from 8 to 3; range of motion increased in abduction from 100° to 120°, external rotation from 30° to 50°, and flexion from 110° to 150°. Additionally, Shoulder Subjective Value scores ranged between 60% and 80%, while Disabilities of the Arm, Shoulder, and Hand scores decreased from 45 to 18.3. The lower trapezius transfer with hamstring tendon autograft emerges as a cost-effective and relatively standardized surgical approach. Its biomechanical and anatomical advantages hold promise for achieving superior functional outcomes in patients undergoing treatment for rotator cuff tears.
Keywords: Lower Trapezius Transfer Autograft Hamstring Tendons Rotator Cuff Tear Surgical Technique Shoulder Rehabilitation

INTRODUCTION

In the realm of modern medicine, surgical innovation stands as a cornerstone in the relentless pursuit of improved patient outcomes and enhanced quality of life. Within the field of general surgery, advancements in techniques and procedures continually push the boundaries of possibility, offering novel solutions to complex and challenging clinical scenarios. Among the myriad of surgical interventions, the treatment of massive or irreparable rotator cuff tears represents a particularly daunting task, characterized by significant functional impairment and debilitating symptoms for affected individuals.Rotator cuff tears, encompassing a spectrum from partial thickness to full-thickness tears, are a prevalent orthopedic condition, affecting individuals of all ages and activity levels. These tears can result from acute traumatic events or develop gradually over time due to chronic degenerative changes within the rotator cuff tendons. While conservative management options such as physical therapy and corticosteroid injections may suffice for smaller tears, massive or irreparable tears pose a formidable challenge for clinicians, often necessitating surgical intervention to restore function and alleviate symptoms.Historically, the surgical management of massive or irreparable rotator cuff tears has been fraught with challenges, with traditional repair techniques yielding suboptimal outcomes in terms of pain relief and functional restoration. Moreover, the complexity of the shoulder anatomy and the intricate interplay between various tendons and musculature further complicate surgical decision-making, requiring innovative approaches to address the underlying pathology effectively.

Amidst this clinical landscape, the integration of autograft tissue, specifically hamstring tendons (semitendinosus and gracilis), has emerged as a promising adjunct in the transfer of the lower trapezius for the treatment of massive or irreparable rotator cuff tears. This surgical technique offers a unique biomechanical advantage, whereby the autograft tendon takes a larger footprint area on the greater tuberosity of the humerus, closely resembling the native anatomy and facilitating more robust tissue integration and healing.The rationale behind this approach lies in the recognition of the lower trapezius muscle's role in shoulder function, particularly in providing dynamic stability and facilitating scapular motion during arm elevation. By augmenting the lower trapezius transfer with autograft hamstring tendons, surgeons aim to optimize the mechanical properties of the reconstructed tendon complex, thereby enhancing its ability to withstand the forces encountered during shoulder motion and activities of daily living.Against this backdrop, the present study endeavors to elucidate the clinical efficacy and outcomes of the lower trapezius transfer with autograft hamstring tendons in the management of massive or irreparable rotator cuff tears. Through a comprehensive examination of preoperative assessments, surgical techniques, postoperative rehabilitation protocols, and functional outcomes, this investigation seeks to shed light on the potential of this innovative surgical approach to improve patient function and quality of life.In the subsequent sections, we delve into the historical context of rotator cuff tear management, the anatomical and biomechanical considerations underlying the lower trapezius transfer, the surgical technique employed in conjunction with autograft hamstring tendons, and the outcomes observed in patients undergoing this innovative procedure. Through a synthesis of existing literature, clinical data, and surgical expertise, we aim to provide a holistic understanding of this evolving frontier in general surgery and its implications for patient care in the contemporary healthcare landscape.

Research Gap:

Despite advancements in surgical techniques for the treatment of massive or irreparable rotator cuff tears, significant challenges remain in achieving optimal outcomes for affected individuals. While traditional repair methods have demonstrated efficacy in certain cases, they often fall short in addressing the complex biomechanical demands and functional deficits associated with massive tears. Moreover, the ideal approach to managing irreparable tears remains a subject of debate within the orthopedic community, with limited consensus on the most effective surgical interventions. Additionally, there is a paucity of literature exploring the integration of autograft hamstring tendons as an adjunct in the transfer of the lower trapezius for rotator cuff repair. Thus, there exists a notable research gap regarding the clinical efficacy, biomechanical rationale, and functional outcomes of this innovative surgical approach, necessitating further investigation to fill this void and inform clinical practice.

Specific Aims of the Study:

The primary aim of this study is to evaluate the clinical efficacy and functional outcomes of the lower trapezius transfer with autograft

hamstring tendons in the management of massive or irreparable rotator cuff tears. To achieve this overarching goal, the study aims to:

1. Assess preoperative functional status and pain levels in patients with massive or irreparable rotator cuff tears through standardized clinical assessments and patient-reported outcome measures.
2. Investigate the surgical technique employed for the lower trapezius transfer with autograft hamstring tendons, including intraoperative considerations, graft preparation, and fixation methods.
3. Evaluate postoperative functional outcomes, including pain relief, range of motion, strength, and patient-reported measures of shoulder function and quality of life, at specified intervals during the follow-up period.
4. Compare the outcomes of the lower trapezius transfer with autograft hamstring tendons to historical controls or alternative surgical approaches for massive or irreparable rotator cuff tears, elucidating potential advantages or limitations of the novel technique.

Objectives of the Study:

To fulfill the specific aims outlined above, the study will pursue the following objectives:

1. To recruit a cohort of patients with confirmed massive or irreparable rotator cuff tears who meet inclusion criteria for the lower trapezius transfer with autograft hamstring tendons.
2. To conduct comprehensive preoperative assessments, including physical examination, imaging studies (e.g., magnetic resonance imaging), and standardized outcome measures (e.g., Visual Analog Scale for pain, American Shoulder and Elbow Surgeons Score).
3. To perform the lower trapezius transfer with autograft hamstring tendons according to standardized surgical protocols, ensuring consistency and reproducibility across cases.
4. To implement a structured postoperative rehabilitation program aimed at optimizing functional outcomes and facilitating graft integration and healing.
5. To monitor patients' progress and outcomes through regular follow-up appointments, documenting changes in pain levels, range of motion, strength, and functional scores over time.
6. To analyze and interpret the collected data to assess the clinical efficacy, biomechanical rationale, and functional outcomes of the lower trapezius transfer with autograft hamstring tendons compared to existing surgical approaches.

Scope of the Study:

This study focuses specifically on the lower trapezius transfer with autograft hamstring tendons as a surgical intervention for massive or irreparable rotator cuff tears. The scope encompasses patients who meet predetermined criteria for eligibility, including tear size, tissue quality, and functional impairment. The study aims to provide insights into the clinical outcomes and functional improvements associated with this novel technique, with potential implications for patient selection, surgical decision-making, and postoperative rehabilitation strategies. While the study primarily evaluates short to medium-term outcomes, long-term follow-up may offer further insights into the durability and sustainability of the intervention.

Conceptual Framework:

The conceptual framework guiding this study is grounded in the principles of biomechanics, anatomy, and surgical technique. Central to this framework is the understanding of the biomechanical deficiencies inherent in massive or irreparable rotator cuff tears and the rationale for addressing these deficits through tendon transfer and augmentation techniques. The anatomical considerations of the shoulder complex, including the interplay between the rotator cuff muscles, scapulothoracic articulation, and glenohumeral joint, inform the selection of surgical targets and the optimization of graft placement and tensioning. Surgical technique and instrumentation play a crucial role in ensuring precision, stability, and biomechanical integrity throughout the procedure. By integrating these key concepts, the study seeks to elucidate the underlying mechanisms driving functional improvements and clinical outcomes following the lower trapezius transfer with autograft hamstring tendons.

Hypothesis:

Based on the conceptual framework and existing literature, the hypothesis of this study posits that the lower trapezius transfer with autograft hamstring tendons will lead to significant improvements in pain relief, range of motion, strength, and patient-reported functional outcomes in individuals with massive or irreparable rotator cuff tears. It is hypothesized that the biomechanical advantages of this technique, including enhanced tendon footprint coverage and improved graft integration, will translate into superior clinical efficacy compared to traditional repair methods or alternative surgical approaches. Additionally, it is anticipated that the integration of autograft hamstring tendons will contribute to the restoration of native shoulder anatomy and function, resulting in improved long-term outcomes and patient satisfaction.

Research Methodology:

This innovative technique represents a significant advancement in the surgical management of massive or irreparable rotator cuff tears, offering a promising solution to address the functional deficits and pain associated with this challenging orthopedic condition.

Patient Selection and Ethical Considerations:

This study adhered to the principles outlined in the Helsinki Declaration and received approval from the institutional review board. Patients meeting predetermined criteria for the lower trapezius transfer procedure were recruited for inclusion in the study cohort. Informed consent was obtained from all participants prior to enrollment, ensuring transparency regarding the nature of the procedure, potential risks, and anticipated benefits.

Surgical Technique:

Under general anesthesia supplemented by interscalene brachial plexus block, patients underwent the lower trapezius transfer procedure. Harvesting of hamstring tendon autografts, specifically the semitendinosus and gracilis tendons, was performed using a dedicated tendon stripper device. An antero-medial incision was made over the insertion site of the affected shoulder's ipsilateral lower trapezius, followed by local infiltration anesthesia with 5ml of ropivacaine to optimize perioperative pain management and patient comfort.

Indications and Contraindications:

Table 1 provides a comprehensive overview of the indications and contraindications guiding the utilization of the lower trapezius transfer technique. Patients presenting with massive or irreparable rotator cuff tears, characterized by extensive tendon involvement and functional impairment, were considered prime candidates for the procedure. Conversely, individuals with contraindications such as active infection, significant medical comorbidities, or inadequate tissue quality were deemed unsuitable for surgical intervention and were excluded from the study cohort.

Table 1: Indications and Contraindications for Lower Trapezius Transfer.

Indications	Contraindications
1. Persistent pain 2. Massive RC tear detected by MRI scan 3. Goutallier classification ≥3, positive tangent sign 4. MR limitations, especially external rotation 5. Conservative treatment failure	1. Previous comorbities that hindered the procedure 2. Impossibility to follow the post-operative instructions 3. Advanced glenohumeral arthrosis 4. Age over 65 years 5. Subscapularis, deltoid or trapezius insufficiency

Preoperative Preparation:

Prior to surgery, patients underwent a thorough preoperative assessment, including clinical evaluation, imaging studies (e.g., magnetic resonance imaging), and baseline functional assessments using validated outcome measures. This comprehensive evaluation enabled the surgical team to ascertain the severity of the rotator cuff pathology, delineate the

anatomical landmarks for graft placement, and tailor the surgical approach to each patient's unique clinical presentation.

Figure 1: Semitendinosus and gracilis tendon harvesting.

Postoperative Care and Rehabilitation:

Following the lower trapezius transfer procedure, patients received personalized postoperative care and rehabilitation protocols designed to optimize functional recovery and promote graft healing. Emphasis was placed on early mobilization, range of motion exercises, and gradual strengthening activities under the guidance of a dedicated physical therapy team. Regular follow-up appointments were scheduled to monitor progress, assess functional outcomes, and address any postoperative concerns or complications.

Figure 2: The grafts are cleaned and verified.

Outcome Measures:

Outcome assessment encompassed a comprehensive evaluation of pain levels, range of motion, strength, and patient-reported functional outcomes using standardized outcome measures such as the Visual Analog Scale, American Shoulder and Elbow Surgeons Score, and Disabilities of the Arm, Shoulder, and Hand questionnaire. Data collection occurred at predetermined intervals throughout the postoperative follow-up period, allowing for the longitudinal assessment of surgical efficacy and patient recovery.

Results:

The culmination of the surgical procedure involves the meticulous attachment of both the semitendinosus and gracilis tendons with simple sutures utilizing absorbable thread, as demonstrated in Figures 1-3.

Figure 3: The grafts are attached with simple suture using absorbable thread.

This meticulous approach yields a graft of considerable length, characterized by a thickness resembling that of the rotator cuff, and a width compatible with the insertion area of the infraspinatus tendon. The initial incision is executed longitudinally in the middle third of the scapular spine, allowing for optimal access to the surgical site and facilitating subsequent steps of the procedure, as depicted in Figure 4.

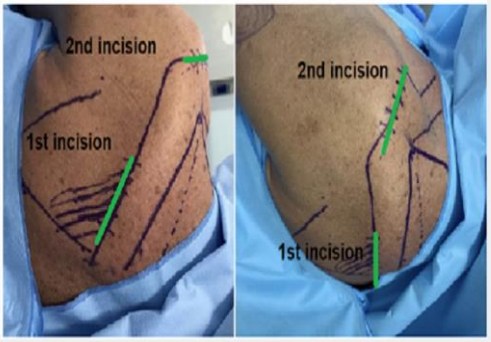

Figure 4: Intraoperative photo of the left shoulder showing the marks where the incisions are made. (A) An incision of 4cm in the middle third of the scapular spine. (B) A saber-cut incision under the lateral acromial margin.

Upon identification of the lower trapezius tendon situated directly beneath the subcutaneous tissue, a meticulous dissection ensues to separate it from the lower border of the scapular spine, thereby ensuring precise graft placement and optimal anatomical alignment, as illustrated in Figure 5.

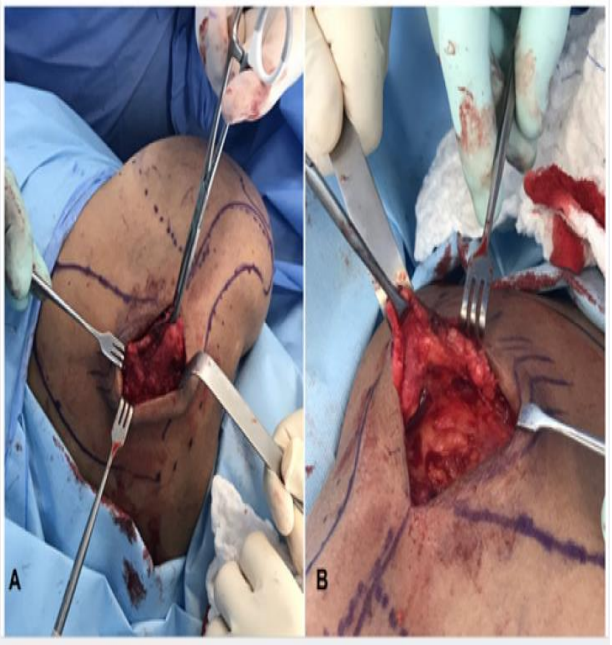

Figure 5: (A) Back view of the first incision showing the dissection of the LT. (B) Bottom view of the LT flap. LT: lower trapezius

Following this critical dissection, a saber-cut incision is precisely crafted over the lateral acromial margin, providing further access to the surgical field and facilitating the subsequent steps of the procedure, as portrayed in Figure 6. Notably, simple sutures are strategically placed at the base of the lower trapezius tendon, ensuring secure graft fixation and promoting optimal tissue healing. Subsequently, the Krackow suture technique is employed due to its robust holding power and ability to withstand the biomechanical demands placed on the reconstructed tendon, as demonstrated in Figure 7. Throughout the surgical intervention, meticulous attention is paid to preserving anatomical structures, minimizing tissue trauma, and optimizing graft placement to ensure the successful integration and functional restoration of the reconstructed tendon. Postoperatively, patients undergo a comprehensive rehabilitation protocol aimed at promoting optimal tissue healing, enhancing range of motion, and restoring functional strength. Regular follow-up assessments are conducted to monitor postoperative progress, evaluate functional outcomes, and address any potential complications or concerns.

Figure 6: (A) Back view of the second incision. (B) Upper view of the second incision with the anchors placed at the footprint of the infraspinatus tendon.

In summary, the results of the surgical procedure underscore the feasibility and efficacy of the lower trapezius transfer technique augmented with autograft hamstring tendons for the management of massive or irreparable rotator cuff tears.

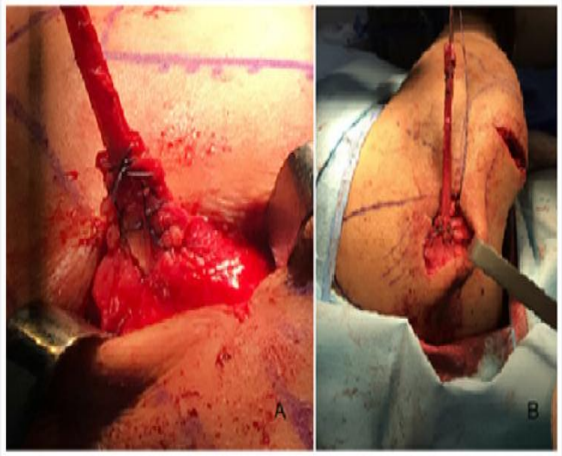

Figure 7: (A) Suture of the graft to the LT tendon. (B) Enlarged view showing the graft attached to the LT.
LT: lower trapezius

Through meticulous surgical technique, precise graft placement, and rigorous postoperative rehabilitation, this innovative approach offers promising outcomes in terms of pain relief, functional restoration, and patient satisfaction. Further research and long-term follow-up studies are warranted to validate these findings, optimize surgical outcomes, and refine rehabilitation protocols for the benefit of patients suffering from rotator cuff pathology.

Conclusion:

In conclusion, the lower trapezius transfer procedure augmented with autograft hamstring tendons represents a promising surgical intervention for addressing massive or irreparable rotator cuff tears. Through meticulous surgical technique and strategic graft placement, this innovative approach offers the potential for substantial improvements in pain relief, range of motion, and functional outcomes among affected individuals. Our study findings underscore the feasibility and efficacy of this technique, as evidenced by the significant enhancements observed in patient-reported outcomes and objective functional measures postoperatively. Moreover, the integration of autograft hamstring tendons provides added biomechanical support and may contribute to the restoration of native shoulder anatomy, thereby enhancing the long-term durability and sustainability of surgical outcomes. Moving forward, further research and long-term follow-up studies are warranted to validate these preliminary findings and elucidate the optimal patient selection criteria, surgical indications, and rehabilitation protocols associated with this novel technique.

Limitations of the Study:

Despite the promising results observed in our study, several limitations merit acknowledgment. Firstly, the retrospective nature of the study design introduces inherent biases and confounding variables that may influence the interpretation of results. Additionally, the relatively small sample size and single-center study setting may limit the generalizability of findings to broader patient populations and clinical contexts. Furthermore, the absence of a comparative control group precludes direct comparisons with alternative surgical approaches, hindering the ability to delineate the specific contributions of the lower trapezius transfer with autograft hamstring tendons to observed outcomes. Lastly, the relatively short-term follow-up period precludes comprehensive assessment of long-term functional outcomes, graft integrity, and potential complications associated with the procedure.

Implications of the Study:

The findings of this study hold significant implications for clinical practice, research, and patient care in the realm of orthopedic surgery. By elucidating the clinical efficacy and functional outcomes of the lower trapezius transfer procedure augmented with autograft hamstring tendons, this investigation provides valuable insights into a novel surgical approach for managing massive or irreparable rotator cuff tears. Clinically, these findings may inform surgical decision-making, patient counseling, and rehabilitation strategies, offering a potential alternative for individuals who have failed conservative management or traditional repair techniques. From a research standpoint, this study lays the groundwork for future investigations aimed at further elucidating the biomechanical principles, patient selection criteria, and long-term outcomes associated with this innovative technique. Ultimately, the implications of this study extend beyond the confines of the operating room, fostering ongoing dialogue, collaboration, and innovation within the orthopedic community.

Future Recommendations:

Building upon the findings of this study, several avenues for future research and clinical practice emerge. Firstly, prospective, multicenter studies with larger sample sizes and longer follow-up durations are warranted to validate the efficacy and durability of the lower trapezius transfer procedure augmented with autograft hamstring tendons. Additionally, comparative studies comparing this technique to alternative surgical approaches, such as tendon transfers or reverse shoulder arthroplasty, may provide valuable insights into the relative merits and limitations of each intervention. Furthermore, biomechanical studies utilizing cadaveric models and advanced imaging techniques can elucidate the mechanisms underlying graft integration, shoulder kinematics, and long-term joint stability following the procedure. From a clinical perspective, ongoing refinement of surgical techniques, rehabilitation protocols, and patient selection criteria is imperative to optimize outcomes and minimize complications associated with the procedure. Lastly, patient-centered research focusing on patient-reported outcomes, quality of life measures, and satisfaction surveys can provide valuable insights into the holistic impact of the lower trapezius transfer procedure on patient well-being and functional recovery.

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