

# Giant atypical lipomatous tumors of the thigh: a case series

*Edoardo Ipponi, Michele Di Lonardo, Elena Bechini, Martina Cordoni, Fabio Cosseddu, Rodolfo Capanna, Lorenzo Andreani*

Department of Orthopedics and Trauma Surgery, University of Pisa, Pisa, Italy

**Abstract.** *Background and aim:* Atypical Lipomatous Tumors (ALTs) are low-grade locally aggressive soft tissue tumors. Deep large sized ALTs of the thigh can cause significant functional impairment due to their mass effect. Surgical resection, which is the treatment of choice for these lesions, can be a tough procedure, especially if the neoplasm comes in proximity with noble structures such as large sized arteries or nerves. The aim of our study is to assess risks and effectiveness of surgical resection, evaluating complications, local recurrences and post-operative functionality. *Methods:* We evaluated all the giant ALT (larger diameter of 10 cm or more) of the thigh that received surgery in our institution between 2017 and 2022. Each patient's personal data and tumor size were evaluated. The quality of surgical margins was analyzed. MRI scans were performed both pre-operatively and during patients' follow-up. Lower limb's functional status was assessed using the MSTS score before and after surgery. Intra-operative and post-operative complications were recorded, as well as local recurrences. *Results:* Twenty-three cases were included in our study. Tumors' mean major diameter was 19.1cm. The mean pre-operative MSTS score was 25.9. Only one case suffered from significant post-operative complications. Only 2 of our cases (8.7%) developed a local recurrence after surgery. The mean post-operative MSTS score was 29.1 *Conclusions:* A careful surgical resection can be effective in treating giant ALTs of the thigh in reason of good functional outcomes, low complications risks and reasonable local recurrence rates. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** atypical lipomatous tumors, ALT, thigh, liposarcoma lipoma like, resection

## Introduction

Atypical Lipomatous Tumor (ALT), also known as Well-Differentiated Liposarcoma (WDLPS), is a locally aggressive low-grade mesenchymal tumor characterized by a predominant adipocytic proliferation (1). These neoplasms are more frequent among middle-aged or elderly people and account for 40-45% of all liposarcomas, representing their most frequent subtype (2,3). ALTs have a predilection for the extremities and the retroperitoneum. They generally present as slow growing painless masses. Distant metastases have been described in literature, although their occurrence is extremely rare (4, 5). Despite their local aggressiveness and their progressive expansion (6), intramuscular

lipomatous tumors can stay asymptomatic for months and years, coming to physicians' attention only when they reach considerable dimensions (7). In some cases, the extension of intramuscular neoplasms can mess up the structure of the muscle itself, thereby reducing its contractile strength (6, 7). The growing mass can also exert pressure on the nearby vessels and nerves, leading to symptoms that could include pain, edema, further reduction in muscular strength and even nerve palsy (8, 9).

Exactly as lipomas, those Atypical Lipomatous Tumors that have a diameter larger than 10 centimeters or weight more than a kilogram can be defined as giant ALTs (10). Due to their size, giant intramuscular ALTs of the thigh are more prone to be symptomatic

and have a higher risk of further malignant degeneration, with a theoretically negative impact on patients' global health and long-term survival (11-13).

To this date, surgery represents the main therapeutic option for the treatment of Atypical Lipomatous Tumors of the thigh and a careful resection of the neoplastic mass is mandatory in order to eradicate the neoplasm. Intralesional approaches or marginal resections should be avoided in areas close to dedifferentiated zones, since they could translate into high rates of local recurrences (6, 12). In parallel, the resection should be carried out identifying and preserving the major vascular and nervous structures in the thigh in order to prevent catastrophic consequences for the homeostasis of the whole lower limb and allow patients' return to their normal activities of daily living. For these reasons, the en-bloc resection of giant ALTs represents a challenging intervention even for the most experienced surgeon.

Due to the rarity of giant ALTs, literature is still poor of large-scale case series on the topic and the pieces of evidence on surgical results have been mostly limited to case reports (1, 4, 10, 12, 14). The aim of our study is to evaluate the results of surgical treatment for giant Atypical Lipomatous Tumors, assessing the effectiveness of the treatments both in terms of disease control and functional recovery.

## Material and methods

This single-center retrospective study was performed in accordance with the ethical standards laid

down in the 1964 Declaration of Helsinki and its later amendments. All patients gave their written consent. Our study consisted of a review of all the patients who suffered from an intramuscular giant atypical lipomatous tumor of the thigh and were treated with surgical resection in our institution between February 2017 and February 2022. Only masses with a diameter larger than 10cm were considered as giant ALTs and included in our cohort. Inclusion criteria were an initial presumptive diagnosis of giant ALT later confirmed by histological evaluation and the absence of pre-operative central neurological diseases or major previous peripheral neurological damages.

For each patient that met the inclusion criteria, we collected data regarding their age, gender and symptoms alongside with the date in which the tumor was diagnosed. For each case, we recorded the time gap between the onset of the first symptoms and the moment in which diagnosis was established (delta-time,  $\Delta t$ ). The pre-operative and post-operative functional status of our patients was assessed using the Musculoskeletal Tumor Society Score (MSTS) both at their hospitalization before surgery and at the moment of their latest follow-up (Table 1).

For each patient, pre-operative MRIs were taken and used to correctly locate masses, estimate tumor size, orientate diagnosis and aid surgical planning (Figure 1).

The date and types of surgeries performed were recorded. The resection was performed aiming for wide macroscopical margins. Surgical approach was designed taking into consideration the localization, the extension and the anatomical relations between the

**Table 1.** The MSTS score for lower limb functionality.

Score	Pain	Function	Emotional	Supports	Walking	Gait
1	No pain	No restriction	Enthused	None	Unlimited	Normal
2	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
3	Modest / non disabling	Recreational restriction	Satisfied	Brace	Limited	Minor cosmetic
4	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
5	Moderate / disabling	Partial restrictions	Accepts	One cane / crutch	Inside only	Major cosmetic
6	Severe disabling	Total restriction	Dislikes	Two canes / crutches	Not independent	Major handicap



**Figure 1.** Pre-operative coronal (A) and axial (B) MRI scans of a giant ALT of the thigh.

lipomatous mass and the nearby vascular and nervous noble structures. These latter were routinely identified and protected through the whole procedure to prevent iatrogenic damages (Figure 2).

Each surgical specimen was measured and sent for histological examination by a pathologist to confirm the diagnosis of Atypical Lipomatous Tumor. At least one surgical drain was set in place before wound closure and removed one the drainage had stopped or had become less than 25ml/day. At the end of the surgical procedure, closed wounds received surface negative pressure wound therapy (NPWT) or compressive



**Figure 2.** An intra-operative picture taken during the resection of a giant ALT of the posterior thigh. The mass is isolated from the sciatic nerve, visible on the inferior end of the surgical field.

wound dressings in order to prevent post-operative seromas or hematomas.

None of our cases received chemotherapy nor local adjuvant treatments.

Post-operative follow-up consisted of seriate office visits, clinical evaluations and post-operative MRIs, focused on excluding local recurrences and assessing the health of the treated thigh. Within the first year after surgery, cases underwent outpatient clinical evaluations and imaging evaluations 1, 3 and 9 months after surgery. In the following five years, cases were evaluated at 6 months intervals. The MSTS scores were calculated according to the combination of data observed and reported by the patients.

Each complication with grade II or higher according to the Clavien - Dindo Classification occurred inside the surgical theater or during the post-operative follow-up was recorded.



## Statistics

Statistical analysis was performed using Stata SE 13 (StataCorp LLC, College Station, TX). Statistical significance was set at 0.05 for all endpoints.

## Results

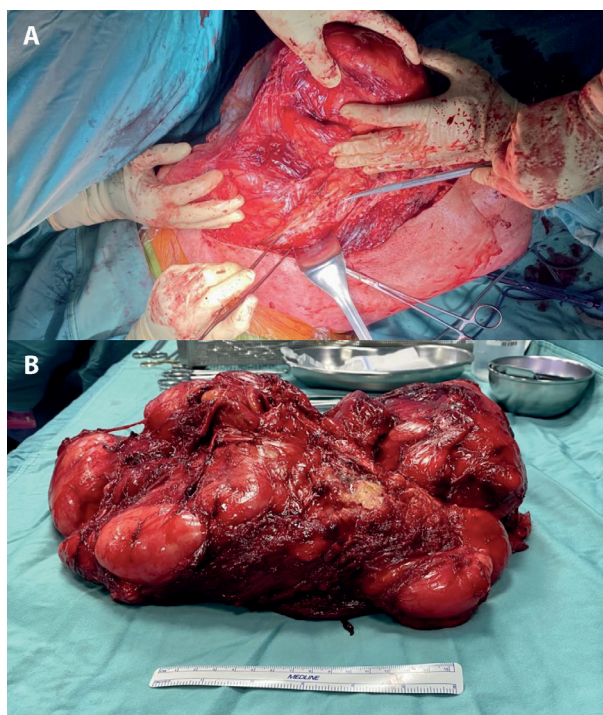
Forty-seven cases suffering from deep lipomatous lesions of the thigh with a diameter larger than 10cm were treated in our institution between February 2017 and February 2022. Among them, 16 (34.1%) cases were histologically diagnosed with high grade liposarcomas, 5 (10.6%) had lipomas and the remaining 26 cases (55.3%) were ALTs.

Twenty-five patients suffering from giant Atypical Lipomatous Tumors of the thigh underwent surgery in our institution between February 2017 and February 2022 and met our inclusion criteria. They were 14 females and 11 males, with a mean age at surgery of 65.9 (45-83) years. Two of them were lost to follow-up, whereas the remaining 23 completed their post-operative intercourse and remained in our study.

Among these 23 patients, 13 came to our attention within one year after the onset of their symptoms, in 3 of them the diagnostic delay was longer than one year but shorter than two years, whereas the remaining 7 cases received a diagnosis more than five years after the appearance of their first symptoms.

Only 2 cases (8.7%) had an at least mild pain (equal or greater than 4 according to the VAS scale) at of their hospitalization. The large dimensions of the neoplasms were responsible for an at least mild reduction of patients' functional status, as testified by a mean pre-operative MSTTS score of 25.9 (17-27).

Tumors were in the anterior compartment of the thigh of 10 cases, in the medial compartment in 2 cases and in the posterior compartment in the remaining 11 cases. According to the pre-operative MRI images, the mean major diameter of the neoplastic masses was 191.1 (105-310) mm. Our population did not highlight statistically significant correlation between tumor size and delta time (Pearson correlation test  $R = -0.085$ ;  $p = 0.700$ ) or pre-operative MSTTS (Pearson correlation test  $R = -0.293$ ;  $p = 0.175$ ).



**Figure 3.** Resection of a giant ALT located in the anterior thigh (A) and exposure of the surgical specimen after en bloc removal (B).

All our cases underwent complete excision of their neoplasm (Figure 3). Excisions were performed respecting the nearby tissues, as the sacrifice of no major arterial vessel nor nervous trunk was made necessary to perform local demolition. The resection was performed with wide margins in 15 cases, whereas a marginal resection was made for the remaining 8 cases. For each patient, the diagnosis of ALT was confirmed by histological evaluations on surgical specimens. None of our cases had major intra-operative complications.

In the first days after surgery, 10 of our 23 cases had compressive wound dressings, while the remaining 13 cases received closed incisional negative pressure wound therapy (ciNPWT).

The mean post-operative follow-up of our population was 30.7 (12-73) months. At their latest follow-up, 21 of our 23 cases (91.3%) were continuously disease free. The remaining 2 cases (8.7%) had a local recurrence, diagnosed respectively within 7 and 12 months after surgery. While none of those who received a wide resection experienced a local recurrence,

this event occurred in 25% of those who required a marginal resection. Although marginal resections were associated with a higher risk of local recurrence, the size of our population did not allow a statistical significance to this finding, as testified by an Exact Fisher Test ( $p=0.111$ ). One of the patients (Case 16) who experienced local recurrence received a further intervention of exeresis and is now free of disease, whereas the other one (Case 22) refused further interventions. None of our cases were diagnosed with metastases.

Only one case (Case 9; 4.3%) developed a seroma, which was diagnosed in the weeks that came after surgery and was successfully treated with an ultrasound-guided percutaneous drainage. No other major complication was reported by any of our patients.

At patients' latest follow-up, their mean MSTS score was 29.1 (14-30). All but two of our cases (91.3%) had an improvement in their lower limb's performances. Only one patient (4.3%), Case 10, had a reduction in his functional status after surgery. Due to the contextual sacrifice of most of her quadriceps femoris muscle, the patient complained of a reduction in her muscular strength and durability, that did not recover despite an intense rehabilitation.

The post-operative MSTS scores resulted to be significantly higher than the ones recorded before the treatment, according to a two-tailed T-Student Test ( $t=3.844$ ;  $p=0.0002$ ). These results testify the effectiveness of surgical treatment in restoring patients' functionality. A resume of patients' pre-operative and post-operative clinical picture is portrayed in Table 2.

## Discussion

Despite their extremely low tendency to metastasize, Atypical Lipomatous Tumors are characterized by a progressive and continuous volumetric expansion (2-5). If a proper diagnostic process is not undertaken in time, these neoplasms could come to reach considerable dimensions and even occupy almost all the volume of the compartment from which they arise. As intramuscular and deep ALTs grow in volume, they take space away from the main muscles of the region, messing up their architecture and possibly reducing their contractile strength. The same mass-effect can

also cause external compression on the major vessels and nerves (15, 16). Surgery represents the main therapeutic option for the treatment of giant ALTs, as a proper surgical treatment could allow the complete eradication of the neoplasm and reduce the pressure exerted on the surrounding soft tissues. Despite these potentialities, the resection of giant ALTs of the thigh can represent a challenging intervention even for the most experienced surgeon. In fact, in order to be effective, surgeons are called to the difficult task of dovetailing an accurate and complete removal of the neoplasm with the care and preservation of the nearby noble vascular and nervous structures.

The resection of the whole mass should be as radical as possible, and surgeons should aim for the widest margins in order to minimize the risk of local recurrence. However, although wide margins of resection are always preferable, the actual role of resection margins is still debated (17-20). In 2015, Kito et al. (20) published a study comparing wide resection with the traditional marginal excision for ALT of the extremities. They highlighted a 0% (0/11) recurrence rate for the widely resected tumors, whereas those marginally excised recurred in 23% (7/30) of the cases. Later, in 2020, Presman et al. [4] had a recurrence rate of 17% among their 36 cases of ALTs. In some cases, especially in large lesions and in complex areas such as the posterior thigh, surgeons might be called to choose between a complete radicality and the preservation of noble structures, due to the proximity of the mass with major vessels, such as the Femoral artery and the Profunda Femoris artery on the medial thigh, or the closeness to large nerves like the Sciatic nerve in the posterior thigh. In fact, the sacrifice of one of these structures could have a dramatic impact on the treated lower limb and undermine its post-operative functionality. For this reason, when approaching giant lipomatous neoplasms, surgeons should always carefully evaluate MRI images and perform an accurate surgical planning (21). Always avoiding an intralesional approach, they may choose to be marginal right next to the aforementioned structures in selected cases. A marginal resection could be acceptable especially in case the major nervous or vascular structures that have to be preserved are surrounded by homogeneous lipomatous tissue, without any septum or macroscopic atypia that might

**Table 2.** A schematic summary of patients' personal data, tumor size and location, pre-operative and post-operative clinical presentation and outcomes.

N	AGE (y)	COMPART.	SIZE (mm)	Δ TIME (M)	PRE-OP PAIN	PRE-OP MSTS	POST-OP MSTS	MARGINS	WOUND COVERAGE	COMPL	LOCAL RECUR.	F-U (M)
1	78	Anterior	250x70x65	60+	Yes	17	30	Wide	NPWT	-	-	12
2	83	Anterior	135x75x50	48	No	26	30	Wide	Compressive	-	-	24
3	58	Anterior	105x50x30	60+	No	26	30	Wide	NPWT	-	-	39
4	55	Anterior	155x45x80	3	No	27	30	Wide	NPWT	-	-	73
5	71	Anterior	190x80x70	6	No	26	30	Marginal	NPWT	-	-	28
6	55	Anterior	135x105x80	4	No	27	30	Marginal	Compressive	-	-	39
7	59	Anterior	190x50x95	3	No	27	30	Wide	Compressive	-	-	19
8	79	Anterior	285x125x155	60+	No	27	30	Marginal	NPWT	-	-	19
9	80	Anterior	145x105x70	60+	No	26	30	Wide	Compressive	Seroma	-	67
10	71	Anterior	215x125x120	60+	Yes	23	14	Wide	NPWT	-	-	27
11	71	Medial	115x25x30	12	No	26	30	Wide	NPWT	-	-	25
12	70	Medial	130x100x75	60+	No	27	30	Marginal	Compressive	-	-	18
13	79	Posterior	150x90x65	10	No	26	30	Wide	Compressive	-	-	37
14	66	Posterior	200x110x115	24	No	27	30	Wide	NPWT	-	-	14
15	70	Posterior	180x100x60	8	No	24	30	Wide	NPWT	-	-	14
16	52	Posterior	160x85x60	3	No	27	29	Marginal	NPWT	-	Yes (7M)	21
17	60	Posterior	280x70x70	2	No	26	30	Wide	NPWT	-	-	63
18	45	Posterior	215x105x85	7	No	27	30	Wide	Compressive	-	-	18
19	53	Posterior	200x100x95	7	No	26	30	Wide	NPWT	-	-	28
20	70	Posterior	310x160x115	60+	No	27	30	Marginal	NPWT	-	-	12
21	65	Posterior	210x135x100	6	No	27	30	Wide	Compressive	-	-	46
22	70	Posterior	230x105x65	12	No	27	27	Marginal	Compressive	-	Yes (12M)	15
23	57	Posterior	210x100x120	36	No	27	30	Marginal	Compressive	-	-	49

Abbreviations: COMPART: Compartment; Δ TIME: Delta time, diagnostic delay; PRE-OP: Pre-operative; POST-OP: Post-operative; COMPL: Complications; LOCAL RECUR: Local Recurrence; (y): Years; (M): Months; (mm): Millimeters

suggest the absence of malignancy in that area. In such situations, the benefit-risk ratio would in fact justify a marginal approach for a low-grade tumor such as ALT (17, 18, 21). This line of reasoning finds confirmation in our cohort, as only 8.7% of treated cases suffered from local recurrences. The remaining 91.3% was continuously disease free at their latest clinical evaluation. Such an incidence confirms what had already been reported in literature by previous studies and testifies that a careful resection can be effective in minimizing the risk of local secondary lesions (4, 5, 12, 14, 17, 19).

Beyond the oncological point of view, the surgical resection of giant ALTs of the thigh also plays a pivotal role in restoring patients' lower limb functionality. In our population, the lower limb functionality had a significant increment after surgery, testifying the effectiveness of the treatment also in terms of recovery of physical performances. This encouraging outcome was also made possible by the fact that none of our cases experienced iatrogenic damages of the major vascular or nervous trunks. These findings are in line with the ones already portrayed in literature by previous case reports (10, 14, 19).

Among our 23 cases, only one developed a seroma in the weeks that followed the intervention. The formation of a cavity within the area that was previously occupied by the tumor represents one of the main threats after surgery, as it could easily be filled with serum or blood, leading to seromas or hematomas respectively (22). Although this risk can not be completely avoided, modern days' surgery offers several strategies to make this less likely to happen. Intra-operatively, a blunt approach to the soft tissues and an accurate local hemostasis are mandatory in order to reduce post-operative bleeding and prevent both seromas and hematomas (23, 24). Surgical drains, for their part, allow the progressive removal of fluids from the surgical bed in the hours and days that follow the intervention (25, 26). Finally, closed incisional negative pressure wound therapy (ciNPWT) has already been reported to be a promising addition to common practices with the aim to prevent the formation of fluid accumulation in orthopedic oncology (27). Our experience testifies that the combination of the aforementioned strategies can

be effective in preventing the formation of large sized hematomas and minimizing the risk of voluminous seromas. The reasonable incidence of these complications in our cohort (4.3%) testifies the effectiveness of an accurate intra-operative hemostasis in association with adequate post-operative wound care. In particular, ciNPWT was effective in preventing the development of post-operative seromas in all the 13 cases that received with VAC therapy. None of our patients experienced other major local or systemic complications such as infections, deep vein thrombosis or embolisms through their entire post-operative follow-up. None of our cases was diagnosed with a metastasis during their post-operative intercourse, thereby confirming how remote is the risk of distant metastases for ALTs (5, 12, 17).

We acknowledge our study is not free of limitations. The rarity of giant Atypical Lipomatous Tumors did not allow us to operate on a wider population, which partially limited the statistical significance of some of the data associations we wanted to investigate at the beginning of our research. Another limitation was attributable to the retrospective nature of our research, which did not allow the complete standardization of intra-operative and post-operative procedures for each patient.

Beyond these limitations, our outcomes suggest that giant Atypical Lipomatous Tumors can have a disruptive effect on the thigh, causing a limitation for some patients' activities of daily living and potentially implying a reduction of patients' quality of life. Although challenging, surgery represents the treatment of choice for these low-grade malignant tumors, providing low recurrence rates, good chances of a satisfying functional restoration and reasonable complications' risks. An early diagnosis of these lipomatous lesions would still be recommendable, in order to prevent excessive growth of the neoplastic masses and therefore allow a less extended surgical resection.

In conclusion, our outcomes suggest that surgery can be effective in treating giant Atypical Lipomatous Tumors of the thigh with the aim to eradicate the tumor and restore patients' lower limb performances.



**Informed Consent:** All patients gave their written consent.

**Conflict of Interest:** Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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**Correspondence:**

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Edoardo Ipponi, MD

Department of Orthopedics and Trauma Surgery, University of Pisa

Via Paradisa 2, Pisa, 56124, Italy

E-mail: edward.ippo@gmail.com