AN ANATOMIC STUDY OF LATISSIMUS DORSI AND ITS SUITABILITY FOR SPINAL SOFT TISSUE COVERAGE

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ABSTRACT

Introduction: There has been a dramatic increase in spine surgery. New surgical instrumentation and less invasive techniques make surgical procedure faster, safer, achieving better functional results. With this increasing number of operations, the number of back surgery failures has also increased. Complications may be mechanical, biological, or related to problems on instrumentation frames. The rate of spinal infections lies between 3-6 % and it´s still a challenge. After debridement and removal of all infected nonviable soft tissue, it is sometimes difficult to obtain wound closure. Pedicled latissimus dorsi muscle flap coverage provides wound healing by promoting vascularized tissue to reduce dead spaces, enhancing local oxygen delivery, and facilitating antibiotic concentration. Objective: Evaluate the suitability of the latissimus dorsi flap for covering spinal skin defects. Material and Methods: 17 cadaveric latissimus dorsi flaps were made, measuring how much they surpassed the middle line at C7, T7 and thocaolumbar transition. Results and Conclusion: This study warrants the suitability of this flap to cover spinal skin defects.

Keywords: *Elderly. Hip fractures. Rehabilitation. Surgery.*

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INTRODUCTION

An increasing trend to surgical treatment of spine pathologies has been noticed in current clinical practice as a result of new technological innovations, making surgical treatment to be more dynamic and safe. In 2006, 500,000 arthrodeses/ year were estimated in the USA,[1-3] evidencing the social impact of spine conditions. This increased prevalence of surgical therapies targeting to provide functional improvement and return to daily activities leads to the increasing number of surgical indications, which will ultimately increase the number of complications in spinal surgery (*fail back surgery*). Complications are biomechanical, biological and psychosocial, including: pseudoarthrosis, neurological lesion, implant failure, infection and postoperative adaptation challenges.

More and more, spine surgeons will be faced with postoperative complications, failures of previous surgeries and spinal infections. An extensive anatomical knowledge of the dorsal region and the mastery of skin tissue coverage techniques will be required for a spine surgeon.[4]

The incidence of postoperative infection following spine surgery is 3-6%.[5,6] At IOT-HC-FMUSP, we found an incidence of 2.56% in elective surgeries and 6.3% in emergency surgeries (trauma) during the period between 2005 and 2006.

There are other risk factors that can contribute to the increased incidence of postoperative infection, such as: *Diabetes Mellitus*, malnutrition, tobacco use, rheumatoid arthritis (due to chronic corticosteroid use), malignant neoplasms, previous spine surgery and obesity.[7]

How to treat Infections after spine surgeries is a controversial matter due to disseminated use of synthesis material that many times cannot be removed due to the risk of producing instability leading to neurological deficit. Literature is controversial in terms of the increase of postoperative infection incidence as a result of the use of implants, with some series describing a postoperative infection rate as high as 20% when implants are used,[8-10] while other series do not report increased infection rates.[11] Some authors believe that the maintenance of an implant favors the development of chronic infection[12], while other authors did not find any increased incidence of chronic osteomyelitis.[13,14] Doubts still exist regarding whether to keep an autologous graft on surgical site or not.[12,15] Once postoperative infection is confirmed, broad spectrum endovenous antibiotic therapy should be introduced, as well as surgical cleaning with rigorous debridement, collection of infection foci material for culture, and use of specific antibiotic therapy, and the benefits regarding implants removal and autologous grafts should be considered on a case by case basis, and, especially, the surgical site must be covered using tissue with good vascular irrigation; therefore, in some situations the use of regional rotation flaps will be required.[13]

This study aims to assess the feasibility of latissimus dorsi flap

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Study conducted at the Institute of Orthopaedics and Traumatology, Hospital das Clínicas - FMUSP
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as a tool for covering failures associated to surgical procedures on the spine based on its posterior rotation.[16] Latissimus dorsi is located on the posterior and lower region of the trunk and scapular waist, has a triangular appearance, the basis of which being spine and the vertex, the axilar region.[17] It has a constant anatomy and vascularization, large size and its muscular core is located posteriorly, which makes it a good choice for spinal coverage failures. Historically, D'Este[18] is recognized as the first surgeon to use myocutaneous flaps. In 1978, McCraw et al.[19] first reported spinal defects coverage. Mathes and Nahai[20] conducted a detailed study of the vascular anatomy of the muscles, where the blood configuration model of the muscle determines how safe it is to transpose it.This study targets the study of the feasibility of latissimus dorsi flap for providing coverage in spine surgery complications as well as in soft parts coverage deficit, infection and surgical site perfusion deficiency.

MATERIALS AND METHODS

Study conducted at the Death Examination Service of São Paulo (SVOC-FMUSP). Thirteen fresh cadavers were selected for anatomical study of latissimus dorsi flap dissection based on its main pedicle, with subsequent ligation of secondary pedicles in order to provide muscle flap rotation. All the selected cadavers did not show structural deformities of the spine, no scars indicative of previous surgery on dorsal region, or *causa mortis* associated to trauma or atherosclerotic vascular disease.
The cadavers were identified for gender, weight and height. Each cadaver was placed at lateral position, and the incision was made from the axil (posterior axilar line) passing through the scapular angle and following until the posterior iliac crest. The lateral edge of the latissimus dorsi muscle was identified and dissected up to its insertions at the spine and iliac crest, sectioning it and ligating secondary pedicles. Identification and dissection of the neurovascular pedicle up to axilar artery at the bifurcation of circumflex arteries of the scapula and thoracodorsal. (Figure 1) The muscle flap was released based on its main pedicle, rotating over it in order to achieve coverage of the cervical (Figure 2), thorax (Figure 3) and lumbar (Figure 4) areas. It was taken as an anatomical repair to measure flap's coverage ability the extension to which it exceeded in centimeters the mid line on the region of the seventh cervical vertebra, the seventh thoracic vertebra and the thoracolumbar transition, as well as the measurement in centimeters of the total extension of the free flap edge. (Figure 5)

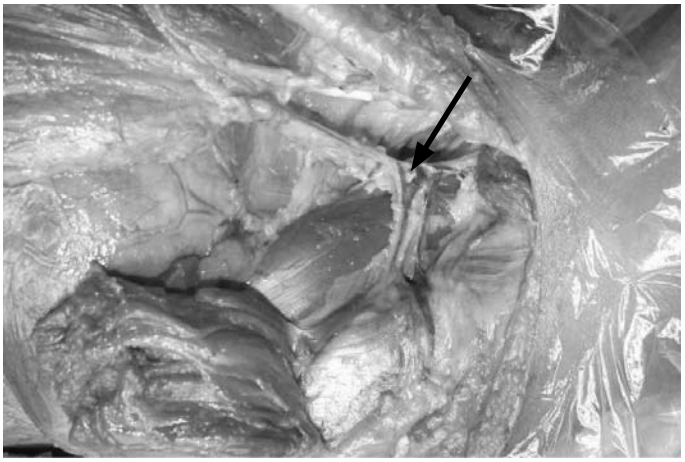

Figure 1 – *Vascular-nervous bundle emergence. Arrow: dissected thoracodorsal artery*

Figure 2 – *Flap reach for cervical spine skin coverage*

Figure 3 – *Flap reach for thoracic spine skin coverage at T7 level*

Figure 4 – *Flap reach for spine skin coverage on throacolumbar transition*

Figure 5 – Flap extension measurement

RESULTS

Seventeen latissimus dorsi flaps were dissected from 13 cadavers between April and July/2007, 8 male and 5 female subjects. All cadavers had the latissimus dorsi muscle and no anatomical variations were found on the main pedicle. The flap exceeded the mid line on the seventh cervical vertebra, seventh thoracic vertebra and first lumbar vertebra 12.46; 13.73 and 10.09 centimeters, respectively. The free flap edge showed an extension of 20.14 centimeters in average. Data from cadaver number 3 were excluded from final result once this flap did not reach the mid line; this happened in 1 of the 17 dissected flaps, preventing the use of latissimus dorsi for spinal coverage in 6% of the cases in our series. (Table 1)

Cadaver	Muscle	Gender	Age	Weight(Kg)	Height(m)	Cervical	Thoracic	TL	Extension
1	1	M	56	60	1.8	18	16	12	
2	2	F	77	38	1.6	8.5	4.8	5.7	
3	3	F	54	50	1.6	*	*	**	13,5
4	4	M	51	68	1.75	10	15	12	20
5	5	F	80	50	1.7	18	19.8	12.8	13,2
6	6	M	66	66	1.7	17	20.2	13.5	18
	7	M	66	66	1.7	18	22	13	21
7	8	M	85	60	1.7	10	13	11	29
	9	M	85	60	1.7	12	14	11	26
8	10	M	52	68	1.8	15	17	11	26
	11	M	52	68	1.8	12	11	11	24
9	12	F	78	70	1.7	16	11	20	26
	13	F	78	70	1.7	4	6	5	30
10	14	M	36	56	1.8	15	16	10	20
11	15	M	63	70	1.75	14	13	10	20
12	16	F	75	60	1.6	1	6	5	25
13	17	M	45	65	1.7	11	15	12	24
Mean			63.37	60.92	1.72	12.46	13.73	10.9	20.14

Table 1 - *Distance from mid line on cervical, thoracic and thoracolumbar region of the studied pieces*

DISCUSSION

The results found in our series allow us to conclude that this flap can be a very good alternative for addressing failures of soft parts coverage and perfusion deficit on cervical, thoracic and lumbar spine.

Authors like Buncke et al.[21] and Lister and Jones[22] tried to determine characteristics that could predict what should be an optimal flap, i.e., minimum morbidity at donor site, little anatomical variation, located on the same body segment as the injured area, multiple use (bone, fascia, skin, nervous), technically feasible and with appropriate pedicle length.

Mathes and Nahai classified latissimus dorsi flap as type 5, being highly safe for rotation both concerning its main pedicle and its dorsal perforating, as well as for its potential use with microsurgical techniques.[20]

From these considerations, many authors have conducted investigations pursuing alternatives for dorsal region coverage. The need to be familiar with the dorsal region anatomy and the mastery of dorsal coverage techniques using rotation flaps have been advocate by many authors.

Some authors advocate the use of paravertebral muscle flaps for being technically easy to get.[4,23] However, Dumanian et al.[4] stress that the use of this technique may cause a further detachment of vertebral musculature, leading to a reduced local perfusion and tissue retraction, which could cause a larger dead space facilitating local infection. In order to avoid these local complications, other authors advocate the use of rotation flap of the latissimus dorsi muscle.[24-26]

We should be attentive to the fact that cadaver studies not always reproduce a feasible clinical outcome, once flap feasibility will depend on its ability to keep a good perfusion throughout its extension.

Based on the favorable results found in our series, we conducted a clinical case for a dorsal sarcoma on a female patient. We employed the muscle-cutaneous form of the latissimus dorsi for a better esthetic adaptation. (Figures 6 - 9)

Figure 6 – *Dorsal ulcerated malignant fibrohistiocytoma, thoracic region*

Figure 7 – *Large defect after oncologic resection reaching close to paravertebral region*

Figure 8 – *Early postoperative period*

Figure 9 – *Final outcome of donor and receptor area*

CONCLUSION

Considering the extensive clinical experience with the use of latissimus dorsi muscle flap, the perfusion safety of its main pedicle, and, essentially, the large safety margin found in our series, i.e., flaps exceeding the mid line in over 10 centimeters, we can conclude that this is a safe alternative for the treatment of spine surgery complications.

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