

ASPECTS OF THE DISTRIBUTION OF MUSCULOSKELETAL TISSUES BY A TISSUE BANK

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ABSTRACT

Objective: Is to evaluate the characteristics of the distribution of these grafts by a Tissue Bank in Brazil. **Methods:** Tissue Bank database from September 2006 to June 2008. The characteristics of the recipients were drawn up in the table form. The types of tissue processed were: femoral heads, metaphyseal-epiphyseal bone, cortical bone, flat or short bones and tendons. The intended purpose of the grafts was analyzed, and distribution frequencies were also obtained and analyzed. **Results:** Altogether, 734 units of fresh-frozen tissue were distributed and transplanted into 683 recipients. In terms of origin of the tissues, 97.9% came from multiple organ donors, and the remainder from living donors. A

total of 489 units of cortical bone were transplanted, 137 of metaphyseal-epiphyseal bone, 44 of short or flat bones, 3 of tendon, 29 of particulate bone and 32 femoral heads. The mean age of the recipients was 50.3 years; 59.5% were women and 40.5% men. The tissues were used in orthopedic surgeries in 21.1% of the cases, and in oral and maxillofacial procedures in 78.9%. **Conclusion:** The Tissue Bank has increased the number of distributions in response to the growing demand for tissues, particularly for use in oral and maxillofacial procedures.

Keywords: Tissue banks. Bone banks. Tissue transplantation. Bone transplantation. Homologous transplantation. Health planning.

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INTRODUCTION

The activities of Santa Casa of São Paulo's Muscle-Skeletal Tissue Bank began in 1995 with the team of the Hip Surgery Division of the Department of Orthopedics and Traumatology. Up to the year 2002, there were 450 tissue harvestings including multiple organ donors and live donors (femoral heads from patients undergoing total hip replacement). These tissues were used in 290 surgeries.¹ From that year on, the Ministry of Health has standardized this practice by means of the legal determination 1.686 GM of September 20, 2002.² In order to comply with this new regulation the Bank was obliged to suspend its activities. In 2005, after adaptations and structuring of modern facilities, financed by Fundação Salvador Arena, the Bank Tissue of Santa Casa of São Paulo has its operation authorized by the Ministry of Health¹. The Bank's activities consist basically of: harvesting, processing, storing and distributing the musculoskeletal tissues within a standardized and rigorous process.³⁻⁵

Autologous bone grafts are the treatment of choice for the correction of most bone defects.⁶ The harvesting of such grafts, however, is not innocuous. In general, a second incision is necessary to obtain the tissue, which may increase the operation time, the bleeding and the local morbidity.^{7,8} These characteristics limit its use in ambulatory regimen procedures, especially in oral and maxillofacial surgery. Besides, the amount of tissue available can be insufficient in case of extensive fusions in spine surgery, reconstruction after resection of bone tumors and in revisions of total hip prosthesis. Homologous grafts are an attractive choice in such cases due to their good osteoconductive potential and availability in larger amounts. Although there are some disadvantages reported with the use of these grafts, such as low osteogenicity and osteoinduction⁹ greater reabsorption rates with lower integration potential,¹⁰ risk of eliciting immunological responses in the transplanted host¹¹ and transmitting diseases,¹² other

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synthetic and biological substitutes alone have not proved to be superior to allograft, and therefore its use has increased in recent years.^{4,5,9,13,14}

The National Transplantation System (SNT) is the government agency in Brazil responsible for the regulation of this activity.² In 2007, altogether 15,855 tissue and organ transplantations were performed in Brazil, of which almost half occurred in São Paulo State. Although musculoskeletal grafts harvested from a donor are legally considered to be transplantation tissue, those official statistics do not take it into account, to date.¹⁵ Estimates provided by the Brazilian Association for Organ Transplantation report annual increases in the number of such transplantations, and in 2007 there were 2340 bone transplantations registered by that association¹⁶. There are six musculoskeletal tissue banks licensed to operate in the country divided into states as follows: three in São Paulo, one in Paraná, one in Rio de Janeiro and one in Rio Grande do Sul. Altogether 45 centers and 128 medical teams are registered to perform musculoskeletal tissue transplantations across the country.¹⁵

The aim of this study is to present the frequency of musculoskeletal tissue distributions by Banco de Tecidos Salvador Arena since the beginning of its activities, as well as, to evaluate the characteristics of these tissues, the receptors and the centers where the transplants were carried out.

MATERIALS AND METHODS

This is a retrospective, descriptive and analytical study of the database of Banco de Tecidos Salvador Arena from September 2006 to June 2008. The epidemiological characteristics (age, gender and type of procedure) of the receptors will be tabulated in EpiInfo 2002 software and presented.

The types of tissues processed were divided into: femoral heads (of live donors or cadavers), metaphyseal-epiphyseal bone, cortical bone, flat or short bones, and tendons. The application of the tissue was divided into: for orthopedic use or oral and maxillofacial use.

The frequency of each type of surgical procedure over the quarters was calculated. The frequency of distributions by type of tissues and application was obtained for each quarter.

RESULTS

From September 2006 to June 2008, 734 units of processed fresh-frozen musculoskeletal tissue were distributed by the Bank. These units were transplanted to 683 different receptors.

The mean age of the receptors was 50.3 years (standard deviation = 14.3 years). Among the receptors, 406 were women (59.5%) and 277 (40.5%) were men.

According to the application of the tissue, 155 (21.1%) were used in orthopedic surgeries and 580 (78.9%) in oral and maxillofacial surgery. According to the origin of the transplanted tissue, 719 (97.9%) specimens were harvested from multiple organ donors and 15 from living donors of femoral heads undergoing total hip arthroplasties.

The frequency of distribution by type of tissue is shown in Table 1. Figure 1 shows the seasonal trends of the amount of distributions and Figure 2, the application of the tissues through the period.

Comparing the distribution rate of the last semesters of 2006 and 2007, an increase of 245% was observed. If we compare the first semesters of 2007 and 2008 the number is 203%.

DISCUSSION

Although the first use of bone allograft was reported by Mac Ewen in 1881 apud Judet¹⁷, it was in the last two decades that musculoskeletal tissue transplantation has been internationally established.¹⁸ Many tissue banks were founded in all continents, gaining greater importance in reconstructive surgeries in various specialties.

In Brazil, the storage of bone allograft tissue banks dates back to the 1960's.³ However, it was only in 2002 that the Ministry of Health established the current regulations for the functioning of Tissue Banks, providing licenses to specialized services to perform this activity.² The activities of Tissue Banks can be split into four phases: harvesting, processing, storing and distribution of tissues.

The characteristics of the donors and the method for harvesting are, among others, determinant factors for the success of the transplantation.¹⁸ The criteria for selection of donors by our Bank are based on the resolution of the Agência Nacional de Vigilância Sanitária (ANVISA, National Sanitary Surveillance Agency) and the technique for harvesting was standardized based on the principles recommended by this agency.¹⁹ One of the main objectives of such standardization is to avoid contamination of the grafts and warrant the safety of the receptors.

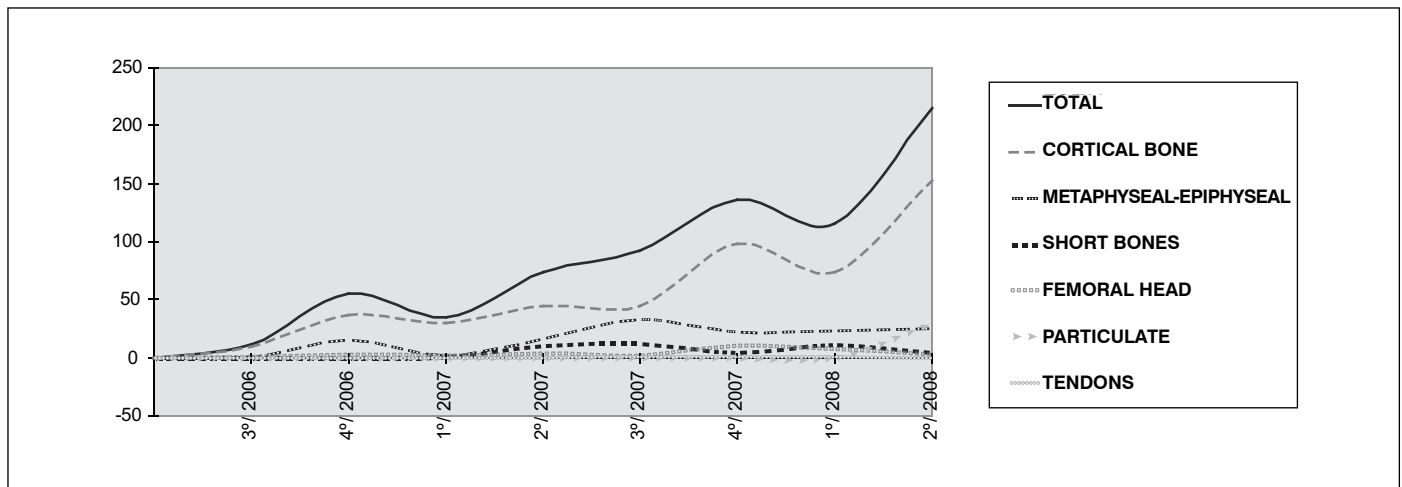
The tissues are processed according to standard procedures and the grafts can be conserved by freezing, lyophilization or demineralization.¹⁹ In our Bank tissues are stored fresh frozen at -80°C. The processing is intended, by manipulation of the tissues, to obtain the specific graft desired for the transplantation. When bone is processed, generally, all soft tissues are peeled off from it (skeletonization process). Nonetheless, cartilage or tendons may be kept adhered according to the application of the graft. One of the advantages of the processing is that it allows one piece to be divided in numerous units, which can benefit a greater number of receptors, avoiding waste of tissue. Besides, it allows crafting customized grafts in size, shape and structure for specific reconstructive procedures on demand.^{5,11}

Although only a few facts relating to distribution of bone tissues is available in the medical literature, this is an essential phase of the process. The characteristics of these distributions relate to the existing demand and steer the need for processing predefined units of a type of tissue for specific applications.²⁰ The observation, for instance, of the increasing demand for bone for use in oral and maxillofacial surgery over the quarters of this study, caused us to modify the processing tactics. All

Table 1: Type of tissue distributed by quarter.

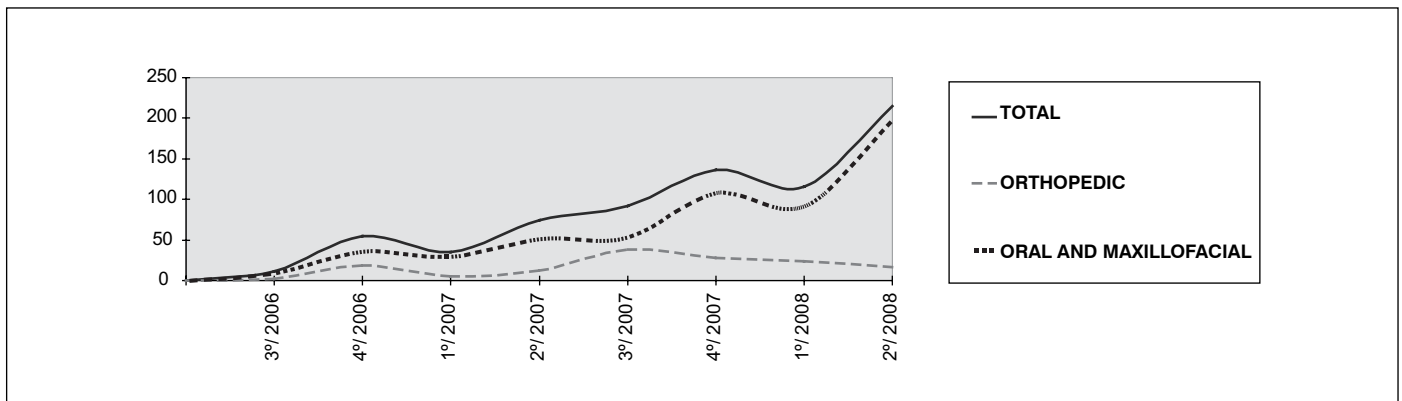
	TOTAL	TYPE OF GRAFT					
		(CORTICAL BONE)	(METAPHYSEAL-EPIPHYSEAL)	(SHORT OR FLAT BONES)	(TENDONS)	(PARTICULATE)	(FEMORAL HEAD)
3rd/ 2006	11	9	1	0	0	0	1
4th/ 2006	55	37	15	0	0	0	3
1st/ 2007	35	30	2	1	0	0	2
2nd/ 2007	74	44	16	10	0	0	4
3rd/ 2007	92	44	33	12	1	0	2
4th/ 2007	136	98	22	5	1	0	10
1st/ 2008	116	74	23	11	1	0	7
2nd/ 2008	215	153	25	5	0	29	3
TOTAL	734	489	137	44	3	29	32

Source: Banco de Tecidos Salvador Arena.



Source: Banco de Tecidos Salvador Arena.

Figure 1: Amount of units distributed by quarter, according to the type of tissue.



Source: Banco de Tecidos Salvador Arena.

Figure 2: Amount of units distributed by quarter, according to the application of the tissue.

those specialists made use of mill rings and rules derived from cortical bone to obtain small fragments of grafts in the operation room, often resulting in the waste of time and tissue; we started to divide these pieces of tissue during the processing, making pre-determined amounts of particulate tissue available. Those units were promptly absorbed by the demand of

those specialists, becoming the preference of most of them. The advantages of this type of use include diminishing the operating time, for it makes additional manipulation unnecessary during the procedure and reduces waste of tissue, as it provides well-defined quantities. Administrative planning, such as disposable materials acquisitions, is possible through the

analysis of these data.²⁰

Added to that, the frequency of distributions and transplantations of musculoskeletal tissue is important data for defining public health strategies. The exact number of such procedures is not available in Brazil.¹⁵ Estimates provided by the Brazilian Association for Organ Transplantation are in accordance with the data presented in this study, for they demonstrate continuous increases in the frequency of bone transplantations in the recent years.¹⁶ The publication of data from the distribution of all the six musculoskeletal tissue banks licensed in Brazil might help to disclose more precise and detailed estimates of such activity in our country. The daily observation makes us believe that the demand for such tissues is much higher than the amount currently made available in the country, and strategies to solve this issue are necessary.

The origin of the tissues in most cases was multiple organ donors in our series. The efficiency of the relationship between the Organ Procurement Organizations (OPO), and the structure of the National System of Transplants (SNT) and of the Health Department of São Paulo State, may help to explain this characteristic of our series. The observation of a growing demand for tissues makes us think of new sources of allograft. The harvesting of tissues in multiple organ donors is limited by the characteristics of these procedures, which demands previous notification of cerebral deaths. In our country, the notification of such events is still low, and the refusal of family members to donate organs of possible candidates is still a reality.^{13, 16} Moreover, many potential donors are excluded for the risk of contagious disease. The Ministry of Health and medical asso-

ciations are responsible for developing strategies to increase the donation rate in our country.^{2,16}

In several institutions the harvesting of tissues after natural death, i.e. in deceased donors is responsible for the majority of the tissues available.¹³ In our Institution an effort is being made to allow harvesting in this kind of donor as a response to the increasing demand verified in this study (above 200% in 1 year).

Another source of tissues is femoral heads of living donors undergoing total hip replacements. The disadvantages are the small amount of tissue provided, which can make the cost prohibitive, and the dependence on previous notification by the surgeon.²⁰ This type of graft is currently being saved in our Bank for patients that will need autologous bone transplantation to another anatomical site. As a frequent example there are patients that undergo total hip replacement on one side and after some time may need a revision surgery with bone graft. In this situation, if there is indication for total replacement of the contralateral hip, that procedure is done prior to the revision and the femoral head is kept for the other side. The specific advantages of this protocol are the reduction of the risk of transmission of contagious diseases and absence of immunological events.

CONCLUSION

The Bank has increased the number of distributions in response to a higher demand for homologous musculoskeletal tissues used in reconstructive orthopedic surgeries and, mostly, in oral and maxillofacial procedures.

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