

# Surface design in the field of health and wellness: a study on the characteristics of three-dimensional textures applied to the myofascial roller product

## *O design de superfície no campo da saúde e do bem-estar: estudo sobre características das texturas tridimensionais aplicadas ao produto rolo miofascial*

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### ABSTRACT

*This qualitative and experimental study is part of an ongoing master's research to map the elementary characteristics of the three-dimensional textures applied to the surface of the myofascial roller, and its projectual and interactive configurations that are important for the praxis of the surface designer working in the medical field. To do so, this study is supported by theories of surface design practices, product design, ergonomics and sensory perception. Semi-structured qualitative interviews were carried out with physiotherapy professionals, in order to understand the importance of three-dimensional textures for the field, along with a systematic review of the literature. Finally, netnography was done on YouTube and on complementary websites. The requirements used for the selection of the analyzed products were availability of digital patents and presence of grid on the surface (term most used in the segment, synonymous with three-dimensional textures). To correlate the collected data with the theories presented, an analysis was made to generate representative content for the field.*

**Keywords:** Three-dimensional textures. Health. Design.

### RESUMO

*Este estudo qualitativo e experimental parte de pesquisa de mestrado em curso, buscando mapear características elementares das texturas tridimensionais aplicadas à superfície do rolo miofascial, suas configurações projetuais e interativas, importantes para a práxis do designer de superfícies que busca atuar na área médica. Para tanto, apoiou-se nas teorias de práticas do design de superfície, projeto de produto em design, ergonomia e percepção sensorial. Foram realizadas entrevistas qualitativas semiestruturadas com profissionais da fisioterapia, a fim de compreender a importância das texturas tridimensionais para o campo, e foi realizada uma revisão sistemática da literatura. Por fim, fez-se a netnografia no YouTube e em sites complementares. Os requisitos utilizados para a seleção dos produtos analisados foram: disponibilidade de patentes digitais e presença de grid na superfície (termo mais utilizado no segmento, sinônimo de texturas tridimensionais). Para correlacionar os dados levantados com as teorias apresentadas, foi feita uma análise para gerar conteúdo representativo para o campo.*

**Palavras-chave:** Texturas tridimensionais. Saúde. Design.

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## INTRODUCTION

In the search for the creation of increasingly suitable products, Baxter (1998) defines that the success of the product development process is due to the construction of well-defined parameters prior to the start of the project. The study and application of ergonomic concepts contribute to adapting objects to human beings, maintaining, above all, safety, comfort, and operational efficiency (GOMES FILHO, 2003). Furthermore, nowadays, user experience has become fundamental for the performance of both product and company in the market. In this sense, sensorial exploration is also an important factor to be considered preliminarily in the project, in the search to understand how more integrated experiences of use can be created.

About the senses, touch may be understood as responsible for the perception of skin contact, being related, therefore, with the way the world around us is felt. Skin, the organ that covers our body, is rich in tactile receptors, playing an important sensory role. It allows interacting with the environment and distinguishing objects, even without seeing them (HAINES, 2006). By sight and — especially — by touch, three-dimensional textures stand out for their notorious interaction with users. They are part of people's daily lives, residing on the surfaces of most objects that surround us. Textures can be arranged in the most diverse types of materials and, according to Kunzler (2003), the most important factors for the perception of surfaces are thermal sensation, hardness, and texture.

By presenting a three-dimensional texture, objects add elements that are not only aesthetic, but also semantic and practical, the latter of greatest interest in this article. According to Falcão (2015), three-dimensional textures applied to the surfaces of objects — such as pedals, buttons, glasses, and cutlery — fulfill functions such as: inducing intuitive use; providing non-slip property; increasing performance in manual activities; preventing vandalism; conferring structural resistance to materials; and even facilitating the dissipation of heat, light, and sound (considering leaked textures).

Surface design is responsible for designing the layer that surrounds or configures the artifacts, that is, surfaces. According to Schwartz (2008), the design activity in this field attributes to the object not only aesthetic, semantic, and practical characteristics (functional and structural), but mainly — through visual, tactile, and embossed textures — it expands sensory-cognitive interactions. By mastering the projective technique for developing new products and, consequently, their surfaces, product designers are also active agents in the field of surface design.

The functional importance of surface design extends from the field of objects to graphic design and fashion, improving user experience in many ways. In order to investigate their contribution to health and well-being — in line with Sustainable Development Goal 3, goal 3.4 (IPEA, 2019) —, a specific niche of products was investigated: those used in rehabilitation activities. Based on an exploratory survey, the myofascial roller was the object selected for its remarkable performance in health care (CHEATHAM; STULL, 2019), in the so-called light physical rehabilitation

(non-permanent health problems), and for its projective potential from the perspective of surface design.

### **Research problem**

Rehabilitation may be defined as the restoration of maximum functional potential in the course of an illness, injury or damage occurrence (SHAH *et al.*, 2015). Rehabilitation levels relate to different limitations and deficiencies presented. However, the Brazilian Unified Health System (*Sistema Único de Saúde – SUS*) is dedicated to serving only people in very severe and evident rehabilitation conditions (blindness, deafness, impossibility of locomotion, etc.), which covers only 2.3% of the population with motor impairments. “Human rights are guaranteed to all Brazilians [...]. However, the primary focus [...] is the segment of people with severe disabilities.” (SECRETARIA DE DIREITOS HUMANOS DA PRESIDÊNCIA DA REPÚBLICA (SDH/PR); SECRETARIA NACIONAL DE PROMOÇÃO DOS DIREITOS DA PESSOA COM DEFICIÊNCIA (SNPD), 2010).

In this way, people with limitations resulting from rehabilitation, or with disabilities and mild disabilities, remain without any medical assistance in the country. Thus, this study sought to observe one of the products used for light rehabilitation, the myofascial roller, aimed at health conditions such as performance problems and capacity limitations without obvious deficiencies, as exemplified by the World Health Organization Family of International Classifications Network (CCOMS, 2003). There are several factors that may lead healthy individuals to light rehabilitation treatments, such as sports practices — which can cause muscle fatigue, sprains or fascial displacement — and recovery treatments after illness, as has been the case with people affected by covid-19 with side effects, such as muscle weakness and atrophy, due to prolonged rest, causing muscle disuse (ANTONIO, 2021).

Currently, on the market, there are several myofascial rollers with different three-dimensional textures applied to the surface, commonly called grid (a word that indicates the creation of textures from an invisible “grid”, “net” or “weave”, with a regular repeating pattern, a “constructive mesh”). This leads to several questions about which would be the best product and the reason for the diversity of grids available. Based on this concern, the objective of the study was to gather information about the characteristics of the three-dimensional textures applied to the surfaces of myofascial rollers, seeking to observe which are the important requirements for the adequate development of new products in the field of health and well-being, in addition to inform potential users on which ones can provide a better user experience and serve that unassisted part of the population.

Theories that support this study are: surface design techniques; product project in design; ergonomics; light rehabilitation; trigger points; and sensory perception.

### **Delimitation of the theme: applied three-dimensional textures**

Present in several fields of design practice, according to Manzini (1993), textures can have an imitative nature, simulating other materials, such as leather, textiles or

natural elements such as leaves and flowers. They can also function as a second skin for objects, which usually happens in the furniture industry, in the lamination of different materials and colors for tables, cabinets, and chairs. In addition, textures can arise as a result of industrial processes, such as parts from foundries, for example, which have an irregular surface, with high roughness. For some authors, the apparent roughness is considered the texture itself, due to the tactile perception it causes. However, Del Curto, Fiorani and Passaro (2010) mention that this “appearance” is one of the constituent parts of texture formation, not being synonymous with it, but a property of the surface due to irregularities.

This study demanded dedication to observe and highlight the three-dimensional textures idealized through projects that have a different concept from those presented above. The idealized three-dimensional textures are those that go through a creation process with interference from designers concerning their details and geometric constitutive elements, such as: shape aspects (graphic motifs); repeating modular pattern (minimum repeatable units constituting the textured surface set); arrangement (mesh of the graphic motif on the surface); and number of repetitions within the analyzed area (density). Thus, the way in which these textures occur will, in fact, be linked to a certain design intention.

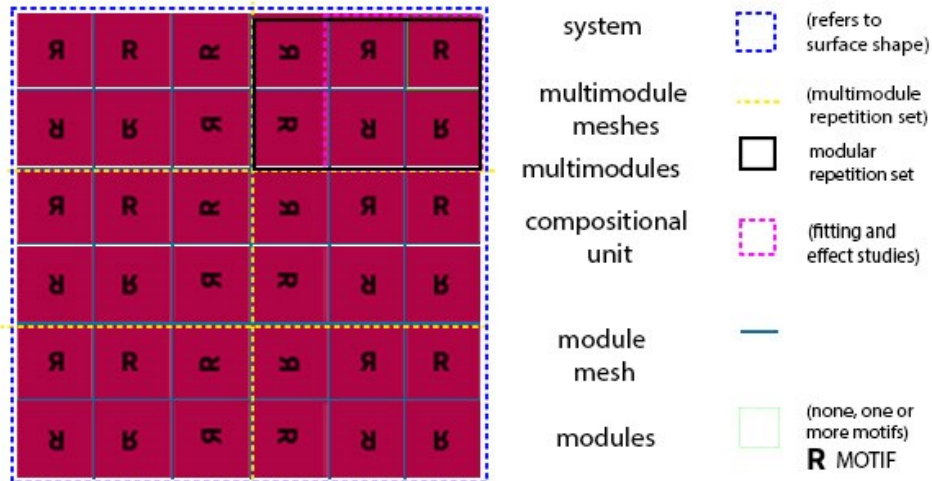
Three-dimensional textures can have several graphic motifs, but the geometric ones were chosen for this study, which are very similar to the element called “embossment”, used in the field of architecture and the arts, due to its intrinsic property of presenting volume and the tactile response it provokes (DONDIS, 2000). However, by the definition of the Encyclopedia (ITAÚ CULTURAL, 2018), embossments are the variation of values on the “z” axis from a flat surface, while three-dimensional textures (although they carry the concept of embossment) can be applied in different base surface geometries, not just plane ones. Visual information is represented by visual, tactile, and embossed textures, while haptic information is represented by tactile textures and embossments, as well as the sensation that the visual texture can evoke.

## LITERATURE REVIEW

Surface design is a specialty that shares some general principles common to all design specialties, such as: engagement with matter; technique; and presence of a creative purpose (FREITAS, 2011). The foundations of surface design came from continuous patterning techniques, which used matrices as a mediation for rotary printing. Even today, with the advancement of technology, these principles are considered as guidelines for new projects.

In his study, Schwartz (2008) outlines a kind of grammar that operates in the plastic-structural configuration of surface design. Figure 1 shows these elements: motif; modules; module mesh; multimodule; multimodule meshes; and system.

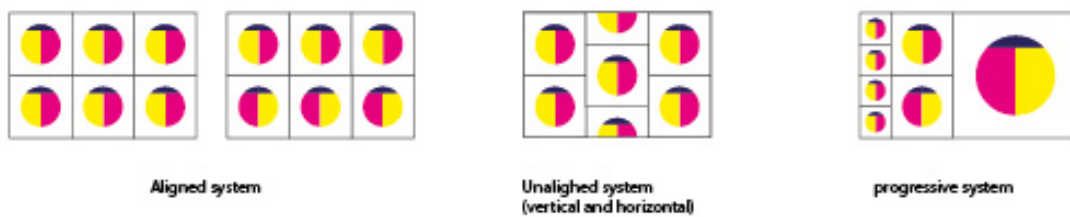
As a definition, the author infers that the role of the “*motif*” is to visually translate the message projected by the designer (SCHWARTZ, 2008). It can be composed of figurative or abstract, geometric or organic elements, have the same formats or variations in color and size. The “*modules*” are one or several compositional



Source: prepared by the authors based on Schwartz (2008).

Figure 1. Relationship of structural elements to the surface design project.

elements (with motifs) that need to be circumscribed in a unit that *will be repeated in the width and length of the surface*. The *module mesh* is the link between modules that focuses on how the fittings between modules work and what effects can be exploited, but which differs from *multimodules*. These are composed of smaller modular systems, as explained by Rüttschilling (2008). This is because the multimodule only exists when this set of smaller modules is repeated from a modular repetition system that is basically configured in three types: aligned, non-aligned, and progressive (RÜTHSCHILLING, 2008) (Figure 2). However, when repeating the module, it is possible to modify its axis and its orientation without changing its design, these modifications are named translation, rotation, inversion, and reflection (Figure 3).



Source: prepared by the authors based on Schwartz (2008).

Figure 2. Relationship of structural elements to the surface design project.

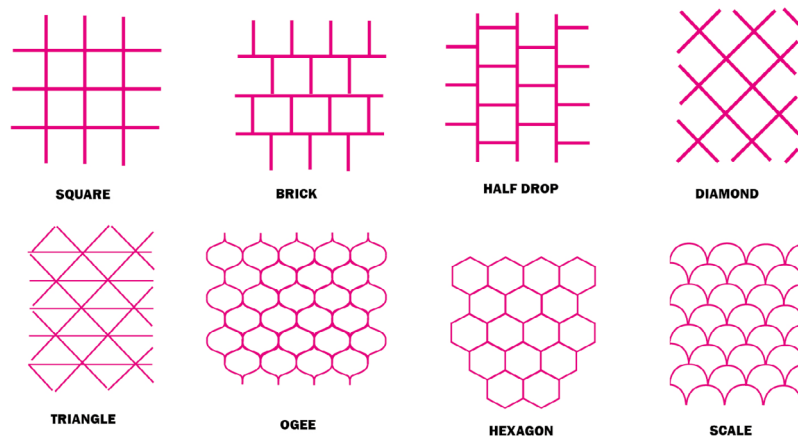


Source: prepared by the authors based on Rüttschilling (2008).

Figure 3. Relation of structural elements to surface design project.

Associated with these concepts is the notion of *rapport*, a French term that means “repetition”. In Brazil, it is more often used in areas related to surface design, to designate the fitting in all directions of the module. In the context of surface design, *rapport* is understood as the adaptation of the module in the printing or manufacturing process. Mcnamara and Snelling (*apud* SCHWARTZ, 2008) point out some of the most used *rapports*: full drop (translation); half drop (translation); brick (translation); stripe (inversion); turn over (reflection on two axes); and mirror and its variations (translational bending, single-axis reflection, and translational reflection). In adapting the module to *rapport*, the adopted repetition system must be considered.

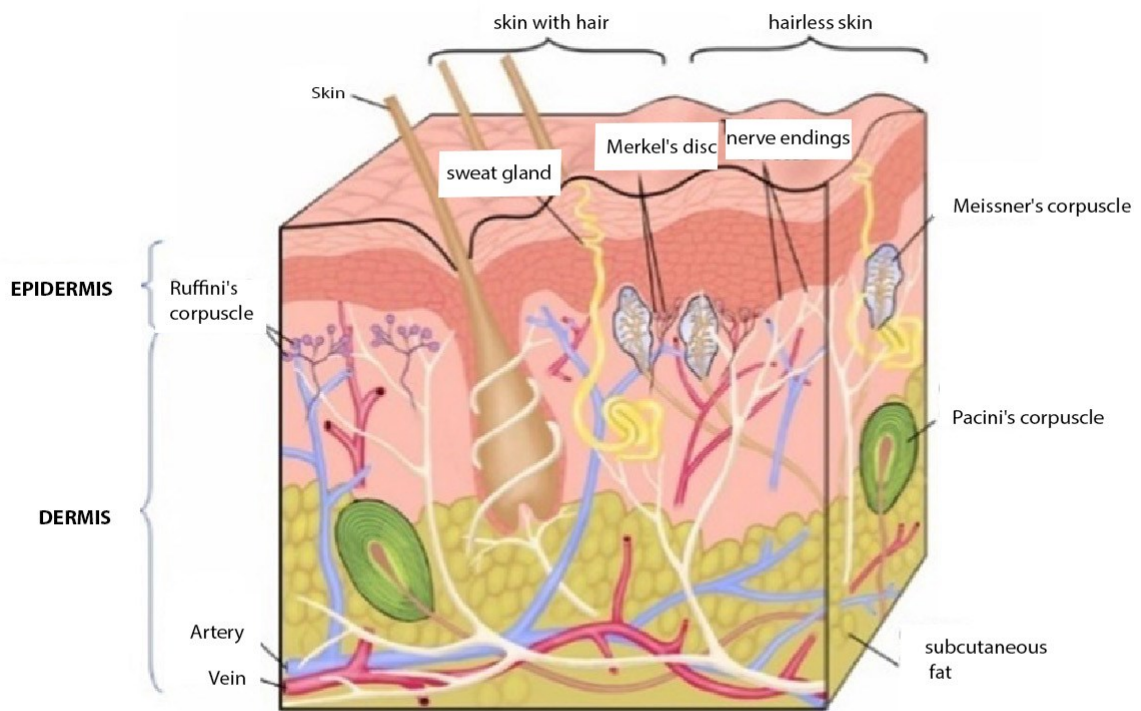
The element “*multimodule mesh*” is related to the geometry of the support surface (product, object, fabric, etc.). This indicates that it can deform for this adaptation. Our object of study, for example, has a geometric structure of a cylinder, but there are products in which the surface becomes more complex. Proctor (1990) defines eight mesh types on which patterns are built: square; brick; half-drop; diamond; triangle; ogee; hexagon; and scale (Figure 4).



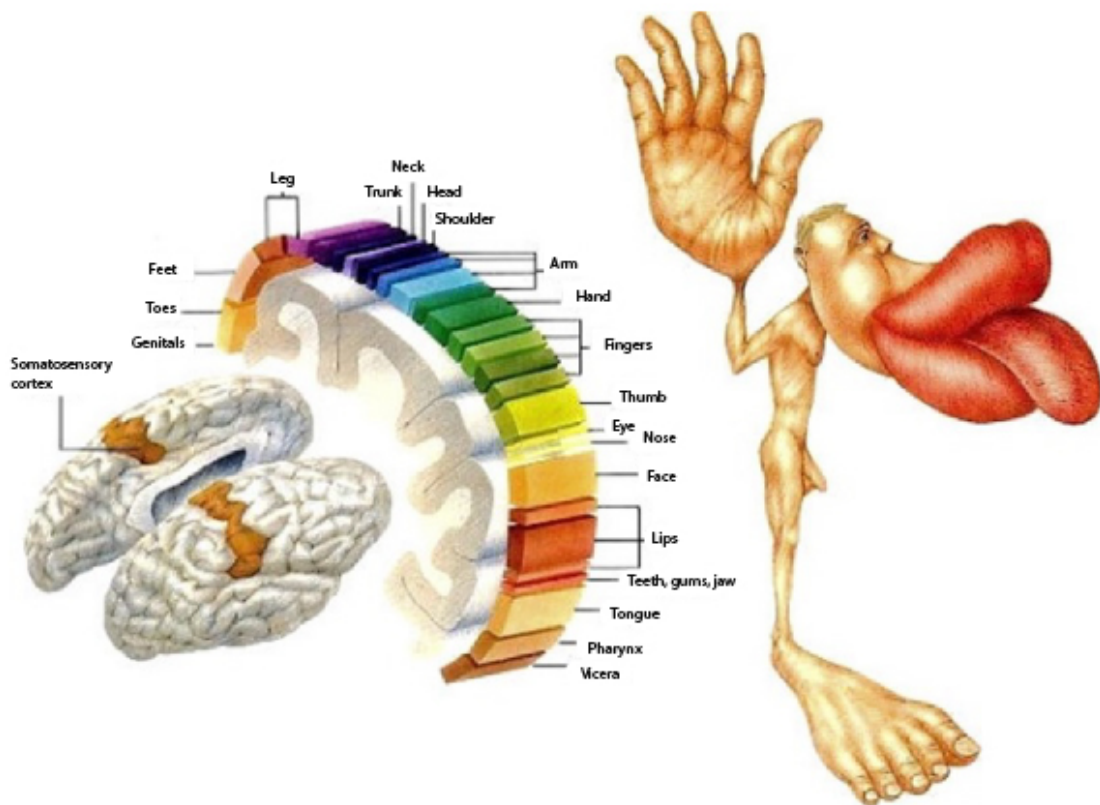
Source: prepared by the authors based on Proctor(1990,p.9)  
Figure 4. Multimodule meshes.

As for tactile perception, according to Haines (2006), one is able to interpret and perceive textures through the sense of touch when provoked by more superficial cutaneous receptors — Meissner’s corpuscle (vibration) and Krause and Merkel’s corpuscle (pressure). In Figure 5, it is possible to visualize the location of the receptors within the skin.

Based on scientific knowledge about the sensory senses, the Penfield homunculus (Figure 6) was created, representing regions with greater density of receptors and greater discriminative capacity. Thus, hands, face, lips, and tongue are much more sensitive than trunk, buttocks, genitals, arms, legs, and feet. Reading the braille alphabet using the fingertips to grope the three-dimensional textures is an example of receptor capture. Furthermore, based on the studies by Haines (2006), it is possible to infer that, in terms of size, regions such as the palm of the hand,



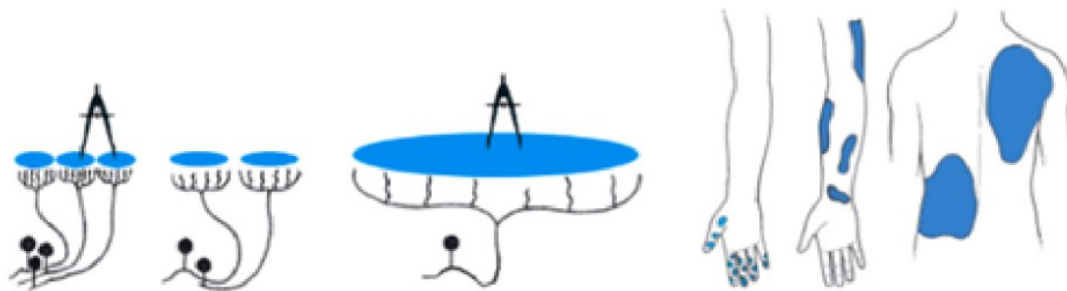
Source: IBB (s. d.).  
Figure 5. Parts of the body with greater and lesser intensity of receptors.



Source: IBB (s. d.).  
Figure 6. Penfield's Homunculus.

fingers, mouth, and feet recognize geometries of small sizes (3 mm) and, in areas such as the arm, back and forearm, recognition occurs with larger sizes (between 5 and 10 mm).

Figure 7 illustrates how the brain understands signals emitted by sensory receptors in different parts of the body. On the hands, there are several blue dots (sensitive points, receptors), while on the back there is a larger blue area (one receiver for a large area). According to Haines (2006), each sensory receptor presents a stimulus reception field that corresponds to its innervation area (blue ellipse corresponding to each neuron).



Source: Haines (2006).  
Figure 7. Regions with receptors.

On sensory-cognitive relationships and interactions, Schifferstein (2011) infers that, from touch, people learn about materiality. He also argues that they can be affectively and emotionally suggested by the way they are touched by objects, being able to distinguish the human-object interaction in touching the object and being touched by it. For Schifferstein (2011), there are several sensory receptors scattered throughout our body that are more intense in certain parts and more spread out in others; in this way, skin sensitivity also changes. Thus, “being touched by something” means communicating with something, making the interaction relationship more intense than when “touching something”. In the world of textures, one can make a parallel by imagining that, when there is direct physical contact with textures, we are touched (stronger sensory physical level) and, when using a second skin to touch something — like a textured thermal glove, for example —, the experience is that of a reduced physical-sensory level.

Despite three-dimensional textures appearing in the face of different materials, it is seen that their occurrence in this material is intense. This is because most industrial processes for obtaining plastic products (such as injected blow molding, extruded blow molding, reactive injection, casting molding, and vacuum thermoforming) can have their tools easily textured.

When investigating the possible actions of textures in the field of health, several articles were found that pointed to possible interactions with textures in various types of health problems, such as visual problems (ARAUJO; SANTOS, 2015; BONONI; DOMICIANO; MENEZES, 2016; CARDOSO ; SILVA; ZARDO, 2017;



SANCHES; BUENO; MACEDO, 2017; KASZUBA; SOBCZYNSK, 2019); Down syndrome with motor problems (GIANLORENÇO; IDE; BRACCIALLI, 2010); fascia problems and pain; in addition to being used in sports injuries and in the recovery of diseases that generate muscle atrophy and weakness due to prolonged rest (ANTONIO, 2021).

According to Niel-Asher (2005), current treatment approaches for pain and problems in the fascia include pharmacological interventions (anti-inflammatories, analgesics, narcotics, and topical creams) and non-pharmacological interventions, such as manual therapies, compression and the so-called myofascial release, which can be done with or without instruments (e.g. the myofascial roller).

The fascia or myofascial release method makes use of a certain pressure that must be applied to the soft tissues, with the purpose of promoting chemical reactions, stimulating mechanical, biochemical, and structural readjustments in the muscles that receive the technique. These readjustments make the muscles slide more easily over each other, promoting greater efficiency in movement patterns. Its purpose is to promote improvement in pain and relaxation of contracted muscles, increase range of motion, in addition to providing increased local circulation (CRUZ *et al.*, 2017).

On the market, there are several myofascial rollers with different three-dimensional textures. Their application depends on the condition of the potential user. There are studies that prove the effectiveness of the instrument (CRUZ *et al.*, 2017) and, according to a study by Cheatham and Stull (2019), those with a textured surface stand out for their greater efficiency, that is, those with a grid. However, even though studies have advanced, the literature on the subject is confusing, which also makes projective (designer) and consultative (users) understanding difficult. According to Shah *et al.* (2015), there is a certain lack of articulation in the scientific literature, despite the increase in clinical studies on muscle pain and trigger points.

## **METHOD**

This article is multimethod. Thus, four different methodological procedures were used, followed sequentially: interviews with specialists; systematic literature review; netnography with market observation; and site and patent research.

### **Interviews with experts**

Three professionals residing in the city of São Paulo and in the ABC region of expanded São Paulo were interviewed. The interviewees were chosen according to the criteria of experience in treatments related to the motor condition of patients and work in the areas of orthopedics or neurology. The ages are varied and the average experience with the activity is five years.

People received two documents via e-mail: the presentation text of the research topic and the informed consent. The script presents nine questions on the theme and semi-structured format. Participants did not have preliminary access to

the questions. Due to the impacts of the pandemic, the interviews were carried out remotely, through the Google Meet application. The interviews were recorded by cell phone, with the consent of the participants, and lasted an average of 30 to 40 minutes. Data analysis was based on the content analysis technique by Martin and Hanington (2012), which presents two main types of approaches: inductive and deductive. In this study, we used an inductive approach.

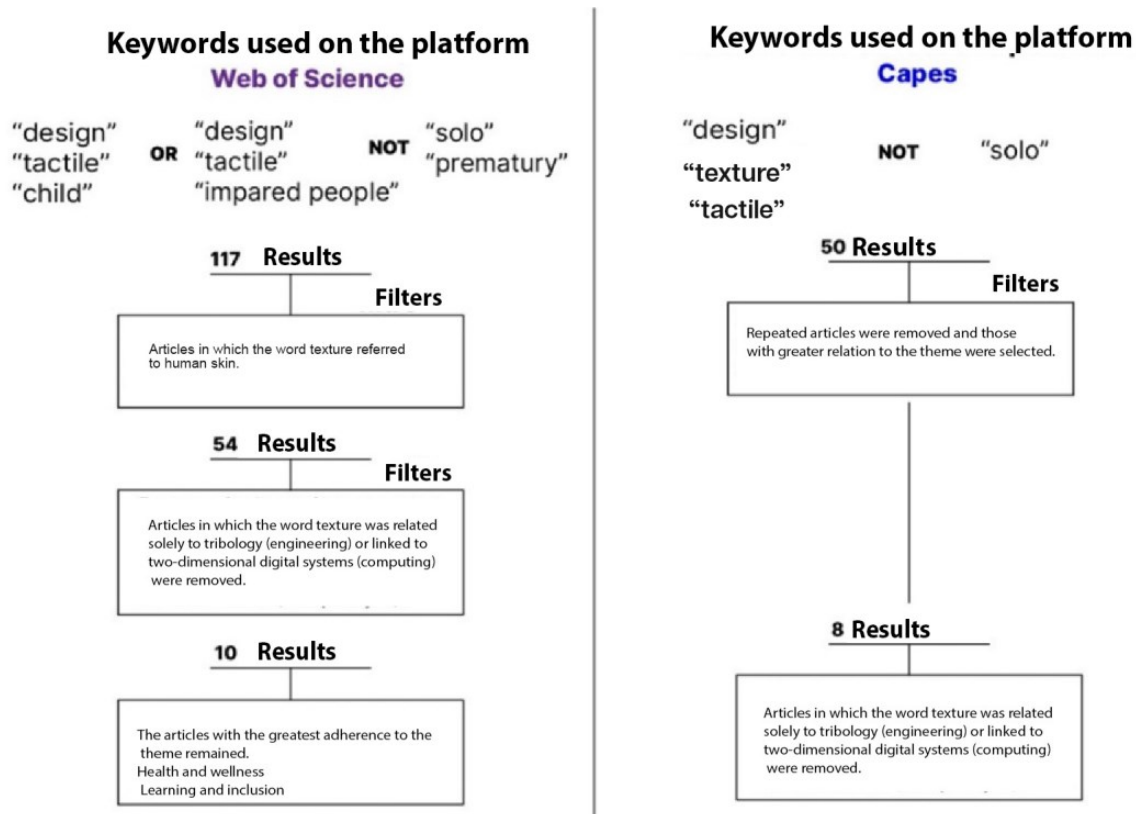
The audios of the interviews were fully transcribed. The interviewees' speeches were inserted into the Miro platform, which assists in the construction of mental maps, diagrams, and notes charts (ARAÚJO, 2019). Then, the text was divided and synthesized into a mental map that represented the chain of ideas with adherence to the general theme of the research and, from this content, categories of study emerged that guided the bibliographical research.

## Literature review

After collecting data from the interviews, a systematic literature review (SLR) was carried out, identifying the main academic discussions on three-dimensional textures applied to health and an unsystematic review specifically on the field of surface design. We sought to identify the main authors, recognize relevant publications, track trends over time, and highlight gaps in the literature commented by specialists. Organized, transparent, and replicated processes were used for SLR, as recommended by the literature (LITTELL; CORCORAN; PILLAI, 2008), in three stages: review planning; conducting the review; and selection of results (TRANFIELD; DENYER; SMART, 2003).

In the first stage, based on conversations with specialists, a general exploratory literature review was carried out, focused on the two main research constructs (three-dimensional textures and health areas). This was necessary to build a knowledge base to plan the SLR about textures applied to the health field. The second stage pointed out by Tranfield, Denyer and Smart (2003) represents the review itself, initiated with data collection. For this stage, the sample of articles was obtained by consulting the databases of the Web of Science and the Coordination for the Improvement of Higher Education Personnel (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* – Capes) in August 2021. The databases were chosen due to the scope of content and ease of importing data.

The following search filters were used in the title, abstract, and keyword list on the Web of Science platform: "design", "tactile", "impaired people" AND "design", "tactile", "child" NOT "solo", "premature". Document type: "Article". The Boolean "AND" was used to expand search results within the delimited theme. The " " symbol was essential to exclude any variation of the searched term, keeping the criteria strict enough to exclude related themes. At Capes, the same logic was used, with the keywords: "design", "textures", "tactile" NOT "solo". Figure 8 demonstrates the rest of the filters applied to the identified samples. At the end of the systematics, 18 articles were obtained in total. For data interpretation, content analysis of the selected articles was performed.



Source: prepared by the authors.  
 Figure 8. Sequence of filters for SLR.

## Netnography

When performing the netnography technique for collection, the researcher defines which data will be verified from the object of study. According to Kozinets et al. (2010), data collection is carried out from three different types of data: archived, with a survey of existing conversations between community members; extracted, obtained from the interaction between researcher and community members; and field notes, generated from the notes taken by the researcher through observation of the community and interactions of its members. In this study, videos and comments from the YouTube community, an online platform that allows the creation and consumption of video content via streaming, were observed (LOPES, 2022). The words “myofascial rollers” and five platform filters were used to select the videos: upload date (1); type(2); sorted by (3); duration (4); and features (5). The filters were configured as: (1) “this year”; (2) “video”; (3) “relevance”; filters (4) and (5) were left open. 97 results were found. As an exclusion criterion, it was defined that the rollers evaluated for the study should have a grid and that the content should have been posted by Brazilians, resulting in 48 videos.

Kozinets et al. (2010) state that data analysis includes the process of transforming the products collected from netnographic observation into field notes. Thus, a field diary was used, an instrument adopted by professors to record their experiences, observations, thoughts, and argumentative perspectives (SOUZA, 2014).

The field diary is an instrument for recording data that allows for systematizing experiences and analyzing results. Thus, the content was annotated on the Miro platform and systematized in Excel. For interpretation, content analysis of the data observed and collected for the study was performed.

### **Site and patent search**

With netnography, it was possible to better map the profile of the product's users and, thus, carry out market research on the product's sales sites and blogs. From the consultation of the websites, three essential pieces of information for patent research were observed: name of the product; manufacturer's name; and origin of the company. The sites selected for this research were Decathlon, Runners, and TriggerPoints.

As most of the products identified were American or European, two platforms for the search were selected: EspaceNetPatent Search (Europe) and Patent Public Search (United States). On both platforms, the expression "self-massage roller" was adopted as a filter. For the final selection, the following criteria were established: be the patent of a product; the product must have a grid; and the patent must have orthogonal views and dimensional information.

316 results were obtained on the European platform and 15 on the American one. After using the filters "GRID" AND "MASSAGE" AND "ROLLER", a total result of 10 patents was reached (adding the two platforms together). For the final analysis, three patents were selected based on the criterion of presenting more information about the products and greater expressiveness for the study. For the analysis, the technique of flattening a geometric solid was used, which is the presentation of all the shapes that constitute its surface in a plane, that is, in two dimensions (SILVA, s. d.).

According to Oliveira (n.d.), the flatness of the cylinder is the two-dimensional representation of the geometric shapes that form this solid. When flattening the cylinder, it is possible to notice that it is formed by two circles, representing its bases, and a rectangle, representing its lateral area. Height and diameter information were found in the patent documents. Following the mathematical expression for flattening the cylinder geometry, with  $\pi$  being a known value, it is enough to apply the values in the formula to find the desired value:  $Ab = \pi r^2$ .

Thus, it was possible to better understand the three-dimensional textures applied to myofascial rollers and to map the essential constitutive elements of the surface design project. From the collected data, the analysis was carried out, seeking to trace relationships between the information and create the content categories that emerged from the study.

## **RESULTS**

The interviews helped define two macro-themes of study for the article, the first being the definition of the product and the second the health area to be explored.

The observation of products with three-dimensional textures used for light rehabilitation treatments was recommended, a situation in which the weaknesses of the users had not compromised their sensitivity and tactile perception. In some rehabilitations, such as brain injury, severe muscle injury such as paraplegia or quadriplegia, amputations, Parkinson disease, multiple sclerosis, etc., the user loses the ability to self-evaluate.

After defining the sample, the SLR data synthesis was conducted. This is the most important stage of the review, generating knowledge based on the collection and subsequent analysis of data (CROSSAN; APAYDIN, 2010). The literature was classified into four categories: learning and inclusion; communication and tactile perception; methods and health; and well-being. Figure 9 lists the author, name of the article, source, and year of publication of the selected studies on the Web of Science and Capes platforms.

As for netnography, the analysis of the material revealed that three categories of videos (“dissemination”, “teaching the myofascial release technique”, and “product use by users”) converged to three user profiles: sports athletes (runners, soccer and volleyball players); people with habit of physical activities (bodybuilding, crossfit, pilates, and ballet); and exhibitors (stores, physiotherapists, personal trainers, etc.).

The most relevant comments posted by potential new users of the product were noted. The biggest questions from users related to the topic of this article were based on:

1. what is the difference between smooth and grid rollers; and
2. which type of texture is best applied to “my” personal limitation (of each subject).

It was observed that all questions were answered in a generic way. In most cases, they were directed to YouTube videos selling the product. The basic answer from the suppliers, in turn, is that the product has several applications and that it is recommended that smooth rollers be used by beginners and textured ones, by people who are used to it, as a kind of gradation of the myofascial release exercise.

### Site and patent search

Among the patents found, the three with the most information about the object of study are presented below, respectively, from the companies MOBOT,<sup>1</sup> Moji,<sup>2</sup> and RumbleRoller<sup>3</sup> (Figure 10).

With the flattening technique of tactile textures of surfaces classified as cylindrical and flattenable by Cavalcanti (2017), the two-dimensional graphic representations shown in the images in Figure 11 were formed.

1 Rolo MOBOT: Available from: <https://mobot.com/products/big-berthade>. Cited on: Nov. 5, 2021.

2 Rolo Moji: Available from: <https://www.amazon.de/-/en/Moji-Heated-Foam-Roller-Microwave/dp/B075K58QRZ>. Cited on: Nov. 10, 2021.

3 Rolo RumbleRoller. Available from: <https://www.amazon.com/RumbleRoller-Original-Textured-Therapist-Technology/dp/B006QMK1FK>. Cited on: Nov. 2, 2021.

Web of Science					Themes
	Authors	Title of the article	Title of the source	Year of publication	
1	Schiatti, L.; Cappagli, G.; Martolini, C.; Maviglia, A.; Signorini, S.; Gori, M.; Crepaldi, M.	A Novel Wearable and Wireless Device to Investigate Perception in Interactive Scenarios	2020 42nd Annual International Conferences of the IEEE Engineering in Medicine and Biology Society	2020	Methods
2	Kaszuba, J.; Sobczynska, K.	The importance of colour and texture in the design of residential interiors, with a particular focus on kitchens for the visually impaired people	Architecture Civil Engineering Environment	2019	Learning and inclusion
3	Oishi, Y.; Imamura, T.; Shimomura, T.; Suzuki, K.	Visual texture agnosia in dementia with Lewy bodies and Alzheimer's disease	Cortex	2018	Health and wellness
4	Ballardini, G.; Carlini, G.; Giannoni, P.; Scheidt, R. A.; Nisky, I.; Casadio, M.	Tactile-STAR: A Novel Tactile Stimulator and Recorder System for Evaluating and Improving Tactile Perception	Frontiers in Neurorobotics	2018	Communication and tactile perception
5	Vaz, R.; Fernandes, P. O.; Veiga, A. C. R.	Designing an Interactive Exhibitor for Assisting Blind and Visually Impaired Visitors in Tactile Exploration of Original Museum Pieces	CENTERIS 2018 - International Conference on ENTERprise Information Systems / ProjMAN 2018 — International Conference on Project MANagement / HCist 2018 — International Conference on Health and Social Care Information Systems and Technologies	2018	Learning and inclusion
6	Zeng, T.; Chen, W.; Li, N.; He, L. Huang, L.	Haptic Perception of Macro Texture	Haptic Interaction: Science, Engineering and Design	2018	Communication and tactile perception
7	Liu, J.; Lin, Z.; Lughofer, E.; Zeng, X.	Aesthetic perception of visual textures: a holistic exploration using texture analysis, psychological experiment, and perception modeling	Uncertainty Modelling in Knowledge Engineering and Decision Making	2016	Communication and tactile perception

Figure 9. Continue...

Figure 9. Continuation.

Web of Science					Themes
	Authors	Title of the article	Title of the source	Year of publication	
8	M, Min-Yuan; L., Ya-Hsueh	Children with autism and composite tactile-visual toys during parent-child interaction	Interaction Studies	2014	Health and wellness
9	Okamoto, S.; Nagano, H.; Yamada, Y.	Psychophysical Dimensions of Tactile Perception of Textures	IEEE Transactions on Haptics	2013	Communication and tactile perception
10	Zuo, H.	The selection of materials to match human sensory adaptation and aesthetic expectation in industrial design	METU Journal of the Faculty of Architecture	2010	Communication and tactile perception
Capes					
11	Cunha, P. V.; Fonseca, L. P.	Signaling system accessible in Braille	InfoDesign : Brazilian journal of information design / Directory of Open Access Journals (DOAJ)	2011	Communication and tactile perception
12	Lima, V. B. R.; Maia, F. N.; Mitre, R. M. A.	The professional's perception of the toy in an intermediary unit of a medium and high complexity hospital	Cadernos de Terapia Ocupacional da UFSCar / Directory of Open Access Journals (DOAJ)	2015	Health and wellness
13	Araujo, M. D. X.; Santos, D. M.	Fotografia tátil: desenvolvimento de modelos táteis a partir de fotografias com a utilização de impressora	InfoDesign: Brazilian Journal of Information Design / Directory of Open Access Journals (DOAJ)	2015	Communication and tactile perception
14	Dischinger, M. C. T.; Kindlein Jr., W.	Metodologia de análise da percepção tátil em diferentes classes de materiais e texturas para aplicação no design de produtos	Design e Tecnologia / Directory of Open Access Journals (DOAJ)	2010	Methods
15	Bononi, J.; Domiciano, C. L. C.; Menezes, M. S.	A criança com deficiência visual: a contribuição do vestuário e do Design de Superfície na percepção tátil infantil	Alma/SFX Local Collection Directory of Open Access Journals (DOAJ)	2016	Communication and tactile perception
16	Gianlorenço, A. C. L.; Ide, D.; Braccialli, L. M. P.	Influência da textura na preensão de indivíduos com Síndrome de Down	Fisioterapia em movimento	2010	Health and wellness

Source: prepared by the authors.

Figure 9. List of articles selected in the systematic review of the literature.

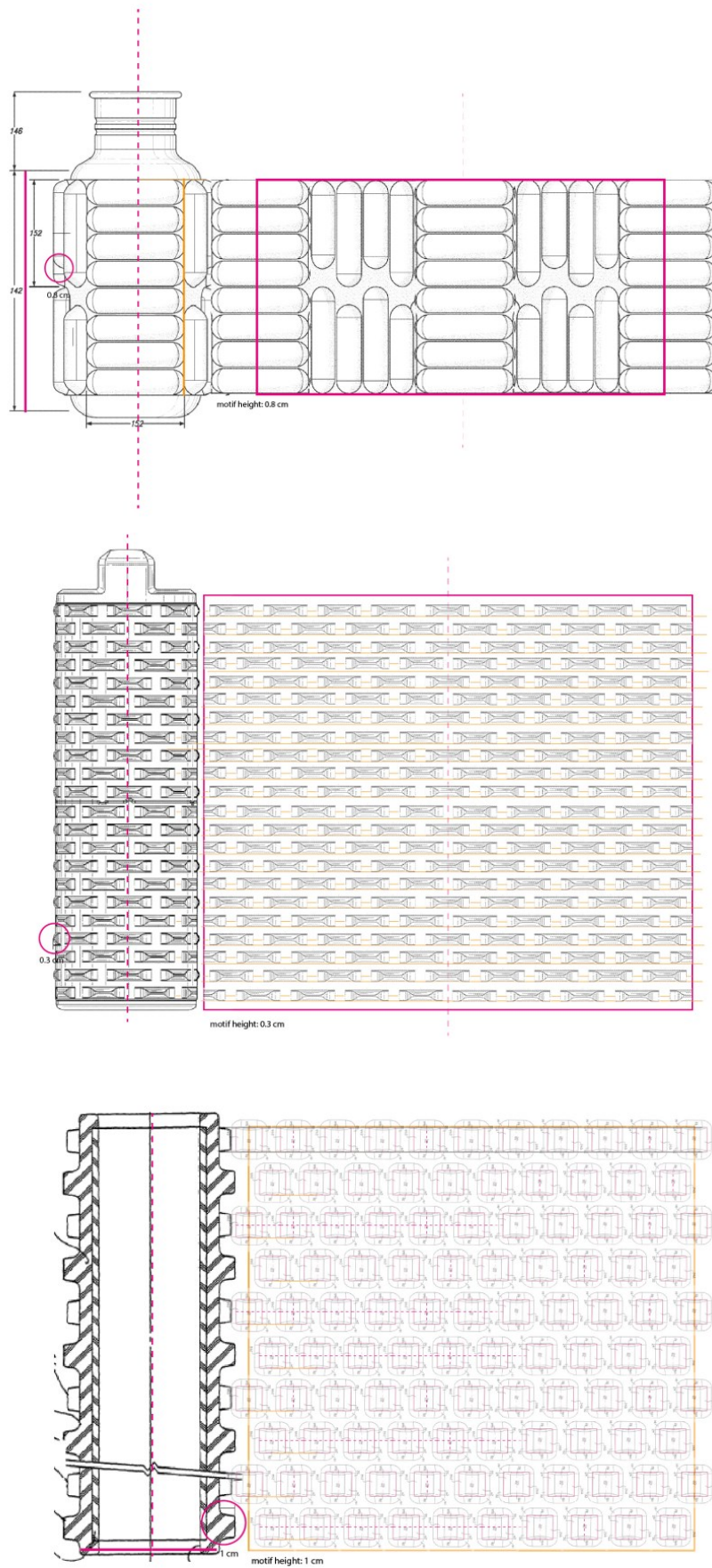
	<b>INFORMATION</b>	<b>PATENT</b>
 <p><b>PRODUCTS</b></p>	<p>Company: MOBOT                      Material: Non-toxic high-density EVA and recycled aluminum                      Dimensions: 23 x 7.5 cm in diameter                      Weight: 298 g                      Supported weight: 160 kg</p> <p><b>Patent:</b> TAYLOR, L. Self- massage roller and bottle                      Applicant: TAYLOR, L.                      Application: Sep. 9, 2014. Allowance: Apr. 21, 2021.                      Available from: <a href="https://mobot.com/products/big-berthade">https://mobot.com/products/big-berthade</a>. Cited on: Nov. 5, 2021.</p>	
	<p>Company: Moji                      Material: Foam                      Dimensions: 33 x 10 cm in diameter                      Supported weight: 138, kg</p> <p><b>Patent:</b> VICTOR, V.; CAVADA, W.; CARHART, C.; SCHWARTZ, W. Massage roller                      Applicant: VICTOR, V.; CAVADA, W.; CARHART, C.; SCHWARTZ, W. 29/586, 888.                      Application: Dec. 7, 2016. Allowance: Nov. 6, 2018.                      Available from: <a href="https://www.amazon.de/-/en/Moji-Heated-Foam-Roller-Microwave/dp/B075K58QRZ">https://www.amazon.de/-/en/Moji-Heated-Foam-Roller-Microwave/dp/B075K58QRZ</a>.                      Cited on: Jan. 15, 2022</p>	
	<p>Company: RumbleRoller                      Material: high density EVA                      Dimensions: 33 x 12 cm in diameter                      Weight: 400 g</p> <p><b>Patent:</b> CHINCHIN, L. Massage roller.                      Applicant: CHINCHIN, L. US 2017/0216133 A1.                      Application: Feb. 1, 2017. Allowance: Aug. 3, 2017.                      Available from: <a href="https://www.amazon.com/RumbleRoller-Original-Textured-Therapist-Technology/dp/B006QMK1FK">https://www.amazon.com/RumbleRoller-Original-Textured-Therapist-Technology/dp/B006QMK1FK</a>. Cited on: Mar. 9, 2022.</p>	

Source: prepared by the authors.  
 Figure 10. Selected myofascial roller models.

Figure 11 demonstrates the three-dimensional texture of the myofascial rollers in a flattened manner. Thus, it is possible to analyze the desired elements, correlating them with information from the literature used. The elements that we sought to identify were: aspects of form (graphic geometric motifs); repeating modular pattern (minimum repeatable units constituting the textured surface set); arrangement (scattering on the surface); and number of repetitions within the analyzed area (density).

Next, the analysis of the contents analyzed is presented and divided into categories for a better understanding of the information.





Source: prepared by the authors.  
Figure 11. Flat pattern of selected roller textures.

## RESULTS ANALYSIS AND DISCUSSION

Four categories of information emerged from the surveyed and systematized content:

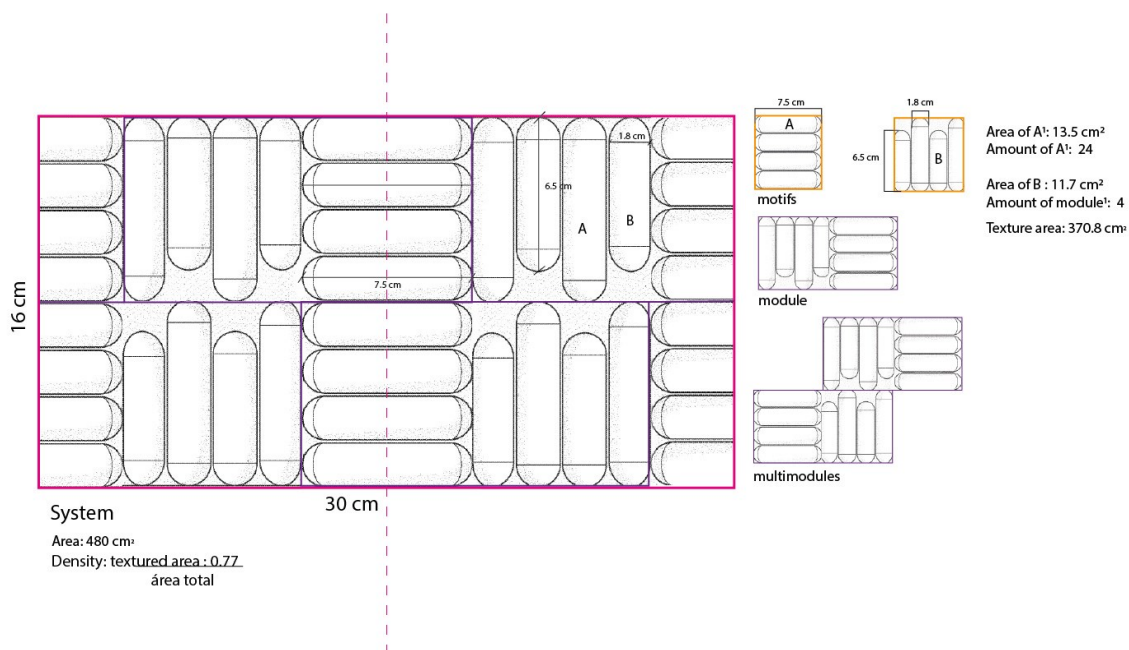
1. "Identification of surface design elements", describing how these elements behave in the selected products;
2. "Profile of product users", pointing out habits and doubts of people who use the object of study;
3. "Ergonomics design elements to benefit the surface design project", identifying objective aspects of the product design that emerged from the study; and
4. "Aspects of experience with the product", analyzing the subjective aspects that emerged from the analysis of user interaction (via netnography) with the product.

### Identification of surface design elements

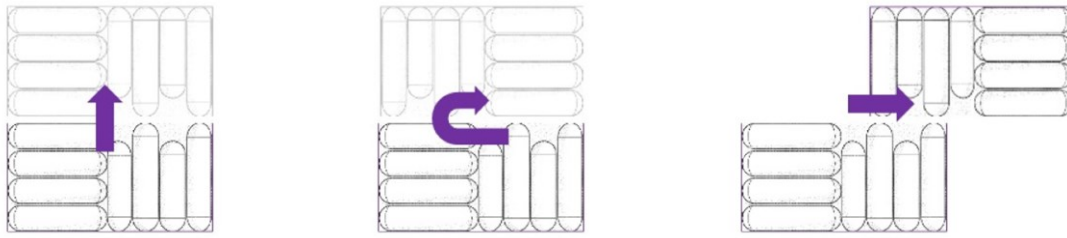
Based on the fundamental elements of the development of a surface design project (SCHWARTZ, 2008; PROCTOR, 1990), the plans made in the myofascial rollers were analyzed based on the survey of patents.

The MOBOT myofascial roller features two graphic motifs and, therefore, its module is made up of these two elements. It was verified the existence of two possibilities of fitting using the system of symmetries: reflection and rotation.

When looking at Figure 12, to build the texture, there is first a reflection upward and then to the side. In this way, one can consider the repetition pattern as not horizontally aligned, remembering that non-aligned systems are those in which the model is displaced in one direction. The mesh structure can be built in two ways and the format used is called brick or square (PROCTOR, 1990) (Figure 13).



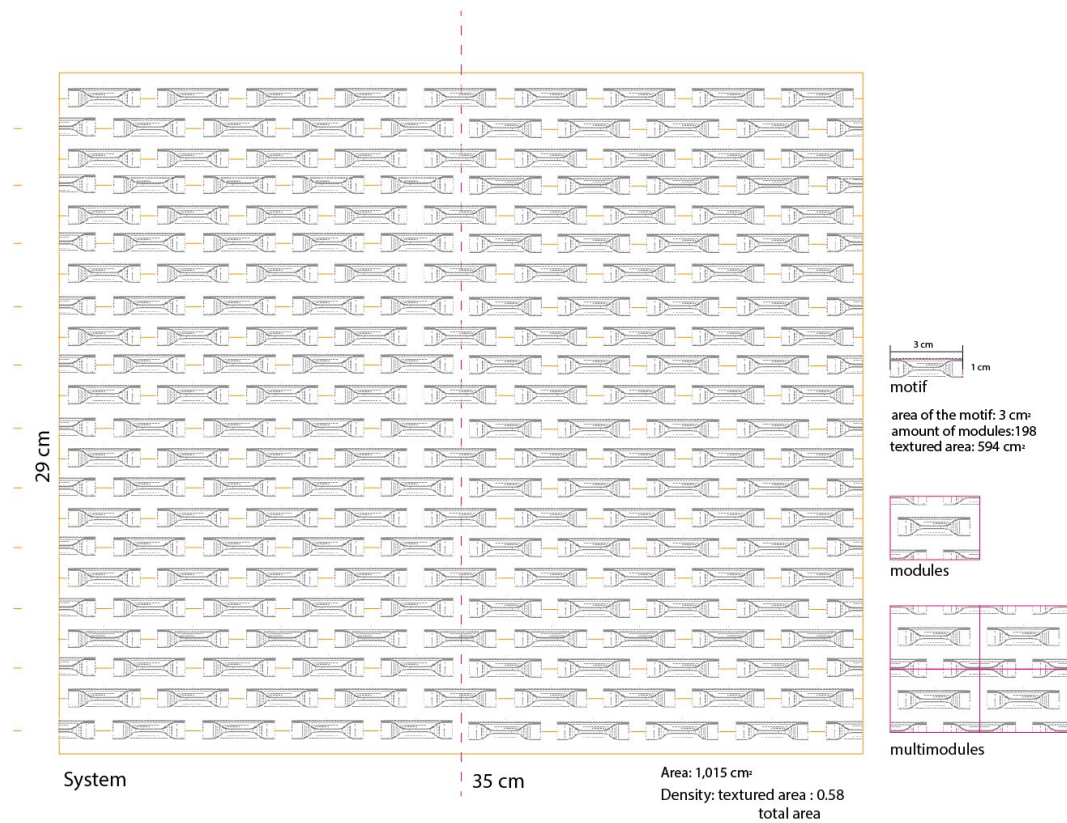
Source: prepared by the authors.  
Figure 12. MOBOT Myofascial Roller.



Source: prepared by the authors.

Figure 13. Structure of modules and symmetries of product 1.

According to Schwartz (2008), it is possible to have one or more motifs in a single surface design project. The Moji Roller only contains one motif; as it is more elongated in the horizontal direction, the system, in general, conveys a perception of being the densest of volumes when compared to the other two products (Figure 14).

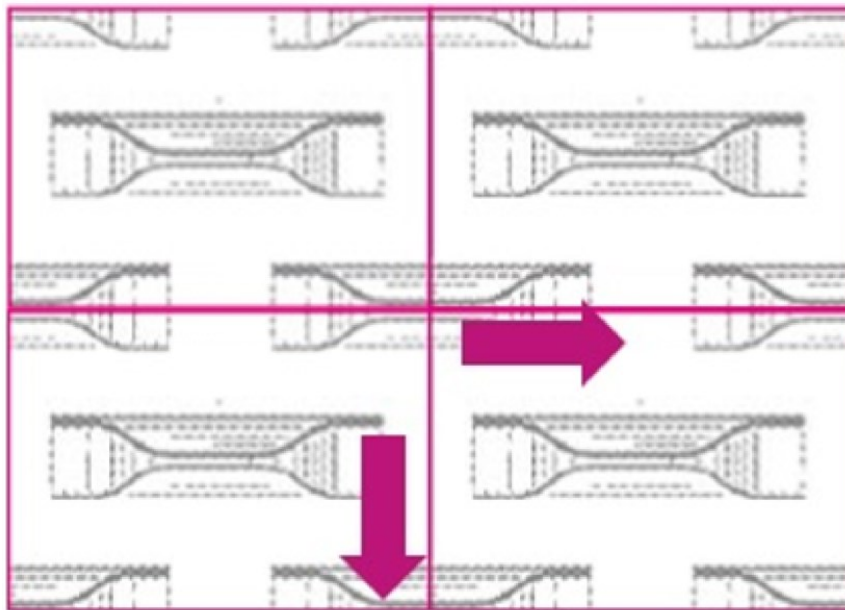


Source: prepared by the authors.

Figure 14. Structure of modules and symmetries of product 2.

The module has the strategy of presenting a centralized motif and, at the ends, it brings four portions of  $\frac{1}{4}$  of the module in each one, allowing the perfect formation of the system, as represented by the flattening of the surface of the myofascial roller.

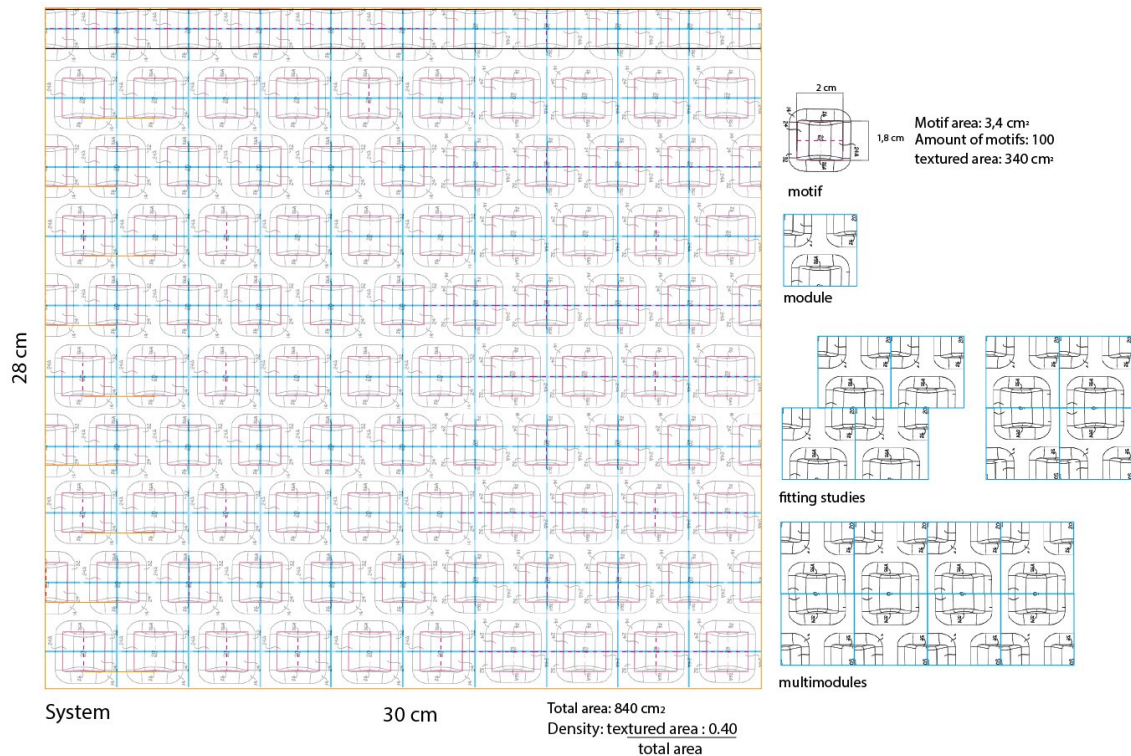
The type of symmetry used can be seen as linear, as it is possible to add more modules both to the sides and up or down (Figure 15).



Source: prepared by the authors.

Figure 15. Structure of modules and symmetries of product 2.

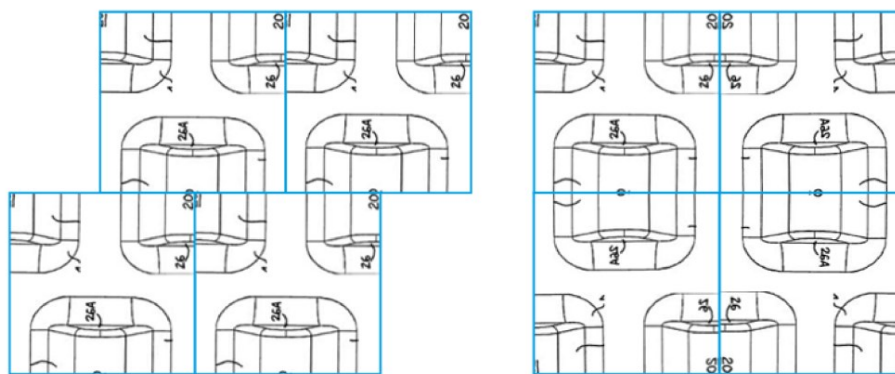
The RumbleRoller also features a unique motif in the graphics system. The strategy used to create the module was to consider half of the central module (close to the base) and  $\frac{1}{4}$  of the two other modules (upper right and upper left), as shown in Figure 16.



Source: prepared by the authors.

Figure 16. Structure of modules and symmetries of product 3.

For the creation of the mesh, two types of symmetry were identified: the first, of the brick type, with the repetition not horizontally aligned (displaced in the horizontal direction with the percentage of 50%); and the symmetry by reflection in the two axes. The complete system is represented by flattening the surface of the myofascial roller, as shown in Figure 17.



Source: prepared by the authors.

Figure 17. Structure of modules and symmetries of product 3.

It is important to note that the MOBOT roller has a higher textured area density, while the Moji and RumbleRoller rollers have lower densities.

Given the above, it is clear that the fundamental elements for the construction of a surface design project were applied to the rollers studied. It is also known that, from the definition of the multimodule, there is rapport. In this sense, the visual elements correctly fulfill the requirements. We still need to better explore the three-dimensional aspects of texture and how they relate to users and generate added value.

### User profile, desires, and doubts

Based on interviews with physiotherapy professionals, the research was directed toward light rehabilitations, considered to be more adequate to the object of investigation. This hypothesis was reinforced by the data survey in netnography. The user profile includes people who practice physical activities, from the most resistive — such as bodybuilding — to relaxation practices and light rehabilitation — such as yoga and pilates. Another important point concerns the effectiveness of the product to prevent and treat muscle pain.

In this sense, it is possible to state that the use of the myofascial roller only for rehabilitation would be incomplete information, as the product strongly helps in maintaining a healthy life.

Most questions concern the different textures available and the best indications for each individual problem. The lack of this information on the products indicates that consulting a health professional is the only safe alternative for choosing the roller or even that the new products should contain more adequate guidance manuals for users.

## **Design elements of ergonomics**

Ergonomics deals with the best adaptation of the product, system or machine to the human anatomy and the task/activity to be performed. Important requirements from the point of view of ergonomics in three-dimensional textures are: tactile interaction; usability; task facilitation; cleaning; and comfort (GOMES, 2003). Knowing the importance of these factors in product development, we tried to consider them in the three myofascial rollers.

### *Tactile interaction*

From the tactile interaction with the product through the skin, it is possible to observe that the understanding of graphic elements (motifs) from touch (tactile readability) applies to the first and third products. According to Haines (2006), thanks to the receptors, although not with all the detailed information, elements with dimensions between 5 and 10 mm can be perceived by sensorial receptors. Thus, it is possible that the user can recognize the presence of two different forms of motifs in the textures.

### *Usability*

The investigated products have different depths, with approximate measurements of: 8 mm (MOBOT roller), 3 mm (Moji roller), and 10 mm (RumbleRoller).

In this sense, it is understood that the MOBOT roller, due to its graphic motifs and intermediate depth, can provide comfort to more specific regions of the body, however, large areas should be avoided due to the small size of the product as a whole, according to the evaluation on the Runners page (HONDORP; NEITZ, 2022, n. p.), specialized in running, aimed at professionals and enthusiasts: “[...] it has a small length that makes it effective for targeted release of trigger points in specific areas. But it wouldn’t replace our top domestic rollers, which are especially good for larger areas like the back [...]”.

RumbleRoller is one of the most praised by runners and performance athletes. It hits spots others cannot and brings relief to users. In the Dicks Sporting Goods community, American website, comments were found such as the one by CURLIEGIRLIE74 (DICK’S SPORTING GOODS, 2015, n. p.): “FINALLY some relief! I have extremely tight gluteus maximus, gluteus minimus, and piriformis muscles and not even trigger point shots have been able to loosen them. So I went out and bought this roller yesterday and finally found relief [...]”.

As for quality, the Moji product is highly praised for its ability to be heated, with no major notes on the effectiveness of the three-dimensional texture in relation to myofascial release. On the American website of Gomoji (2019, n. p.) there are several reports about its thermal quality, such as JEFF J: “This is amazing. Almost like a hot stone massage. Seems pretty good [...]. It gets easier with use. Be aware... this roller is very firm [...]”.

### *Cleanliness, task facilitation, and comfort*

In the first product (following the sequence of Figure 10), it was observed that the three-dimensional textures are well rounded (without corners) and with threads

(large radii of surface junction) that prevent the accumulation of dirt. RumbleRoller features a seamless surface with a larger three-dimensional texture, which helps keep the product hygienic.

The Moji roller has very shallow three-dimensional textures, which facilitates everyday cleaning. Moji and RumbleRoller are made up of just one material; the second does not feature parts division, unlike the MOBOT roller, which is made up of two different materials, in addition to being bicomponent. In this sense, it can be inferred that RumbleRoller is easier to clean compared to MOBOT.

Taking the online journal Padel World Press (2017) as a reference, because they are produced in EVA, the MOBOT and RumbleRoller rollers absorb less vibrations, with a feeling of greater difficulty due to the need to apply greater force to the activity. However, they are more durable. The "foam" material absorbs vibrations better and facilitates the task, as the control over the product, by reducing the force applied in the movement, is greater. However, the material has less durability when compared to EVA.

### *Aspects of experience with the product*

According to Schifferstein and Hekkert (2011), touch is the basis for all knowledge of the material world. Interactions take place through the whole body, not just the hands. In addition, people need touch to understand the world, as identifying objects by touch is different from knowing them by deduction. Along the way, a path is opened for communication and tactile interaction with objects, creating two relationships, in which the object is touched by the user and in which the user is touched by the object. A communication and readability channel is established with the product.

We can think, then, sentimentally and subjectively about this idea presented by the author (SCHIFFERSTEIN; HEKKERT, 2011). However, there are also physical aspects of this relationship, as human skin allows tactile recognition of objects in different ways, by their substance (of which it is made), hardness, plasticity, temperature, weight, structure, moving or fixed parts and, of course, by its surface, where are the textures and constitutive units that we sought to observe.

Analyzing the appearance of the three-dimensional textures applied to the three objects and the interaction relationships with them, it can be inferred that, in product 2, the existing relationship is that the object is touched by the user. This is because, as mentioned, the larger regions of the body, such as the back, have less sensitivity and ability to recognize geometries. Thus, reduced texture thickness and size are not fully identified by users (SCHIFFERSTEIN, 2011). In products 1 and 3, the relationship is that the user is touched by the object, as the size of the textures and their depth allow interpretation by the user and, possibly, even the recognition of their graphic motifs (minimum constitutive unit of texture) by tact. The empirical experimentation of this statement would allow a productive future study within the theme.

## CONCLUSION

This article sought to map constitutive characteristics of three-dimensional textures applied to the surfaces of myofascial rollers, used in light rehabilitation, through visual graphic composition and mainly regarding the impact of these configurations on functional and interactive qualities with their users.

It is concluded that, in many aspects, coherence relations emerged between what is presented in theory and what is proposed in the products. The theory about the fundamental elements for the construction of a surface design project was identified, as well as its expansion. The application of significant three-dimensional qualities to the textures had impacts on the functionality and quality of use of the product, which can be observed mainly by touch, not restricted to the touch by the hands, but by the whole body. The value of the product project developed depends on factors such as aesthetic, functional and relational quality (communication and interaction) in relation to its potential use.

It was noticed that, for the development of new products, more specifically myofascial rollers, it is necessary to survey several preliminary parameters that go beyond the intrinsic aspects for the graphic construction of the two-dimensional texture, contemplating ergonomic, dimensional aspects (depth of the graphic motifs and density), interaction, material and use, not to mention the influence of semantic aspects, which were not addressed here. In addition, it was noticed that the characteristics of the three-dimensional textures used directly interfere with the health and well-being of the identified target audience, collaborating for light rehabilitation and also for the prevention of disabilities.

Given the above, this experimental study, which is still exploratory, sought to identify some preliminary clues capable of guiding the practice of the surface designer, based on the recognition of the area of health and well-being as an interdisciplinary point of exploration. It was observed that it was possible, effectively, to align multiple interests, both in the field of product design and in the orientation of users and manufacturers and in the mapping of some preliminary parameters to be observed in the development of new products.

It is believed that the information raised and treated here can contribute as a reference for future research and for the performance of surface designers.

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