Opinion

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Biotechnology and Non-Bayesian Calculations for the Talus Bone Volume

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ABSTRACT

Keywords: Anatomy; Biotechnology; Non-Bayesian Statistics; Replica Techniques; Talus; Morphometry; Volumetry

Opinion

Anatomical Science Research and Morphometric Studies

Morphometric studies are versatile within the disciplines of human anatomy, comparative anatomical sciences, and physical anthropology [1,2]. The estimation of the volume of skeletal tissues, also known as Volumetry, represents an integral component of morphometry [3,4]. Anatomists and physical anthropologists developed a handful of methods to estimate the accurate size of bones as well as some soft tissues [1,5]. These techniques exploit cast materials, the Archimedes' principles of buoyancy and fluid displacement, replica manufacturing techniques, and radiology-based methods in addition to three-dimensional digital image analysis [5]. The morphometric studies of bones usually focus on quantifying and describing the morphology of irregular geometric shapes, the relevant dimensional parameters, the surface area of articular and the non-articular regions, and volumetric measurements of a whole bone or segments of bone, including tuberosities, tubercles, processes, cavities, sinuses, and others [1,3,4,6]. Volumetry can also apply to cartilaginous tissues and other chemically treated soft tissues of interest. Several morphometric studies neglect the analysis and quantification of volumes and surface areas. As a consequence, those studies are incomplete and of low level-of-evidence as per the proper critical appraisal tools of evidence-based medicine [7].

The Talus Bone, AKA the Astragalus

The talus, also known as the astragalus or the anklebone, is a bone of the tarsus. The tarsus forms the lower part of the ankle joint [8]. The anklebone articulates with the medial and the lateral malleoli of the tibia and the fibula [8]. Within the talo-calcaneo-navicular joint, the astragalus maintains an enduring articulation with neighboring calcaneus and navicular bones [8,9]. For a stable upright posture and energy-economic bipedal locomotion, those sturdy articulations transmit the entire body weight to the foot [8,9]. The anklebone is also one of the bones in the human body to possess the highest surface area covered by articular cartilage. Perhaps, this may associate with its unique retrograde arterial blood supply [10]. In modern humans, there are no muscle attachments to the talus [9]. Its anatomic position is governed by the adjacent bones and ligaments-mediated topographic skeletal arrangement [9,11].

Exploring the Literature for the Highest Level-of-Evidence

We conducted a review of the literature, during the second half of September 2019, via the Cochrane Library [the Cochrane Database of Systematic Reviews], PubMed [the United States National Library of Medicine], and Embase [Elsevier Database | Scopus]. We pragmatically explored the peer-reviewed publications by deploying an elaborate mixture of MeSH-based keywords and generic terms, in combination with truncations as well as Boolean operators, to retrieve potential papers of the highest level-of-evidence in connection with our research topic. We applied keywords that relate to four major themes, including anatomical sciences, the talus bone, morphometric studies, and non-Bayesian between-subjects' statistics. Our review strategy yielded a total count of 494965 publications allocated into the Cochrane Library of Systematic Reviews [9310, 1.88%], United States National Library of Medicine [306842, 61.99%], and Embase [178813, 36.13%] (Table 1A). Based on the combinatorial of the thematic keywords search of the literature and following a full-text retrieval of papers of interest, we were able to discover four potentially-relevant articles authored by Lin (2012), Shingler (2011), de Moraes Silva (2019), and Whitton (2015) (Table 1B). These studies originated from Australia, United Kingdom, Brazil, and the United Kingdom. All publications were systematic reviews, and all of these are indexed in the Cochrane Library as well as the PubMed database. However, only one study by Lin and coworkers (2012) was genuinely relevant to our study [11]. Accordingly, we conclude that there is a notable deficit for reliable and externally valid research of the highest level-of-evidence.

Table 1A: Keyword-Based Exploration of the Principal Databases of Literature for Medical Research.

		Number of Hits per Database			
Theme of Keywords	**Keywords**	**Cochrane Library [Cochrane Database of Systematic Reviews]**	**PubMed [U.S. National Library of Medicine]**	**Embase [Elsevier Database]**	**Total**
Anatomical Sciences	anatomy OR anatom* OR human anatomy OR human anatom* OR comparative anatomy OR compar* anat* OR physical anthropology OR anthropology OR phys* anthr*	1118	2736	28903	32757
Talus Bone	Talus OR astragalus OR astragal OR ankle OR bone ankle bone	337	81646	10904	92887
Morphometric Studies	morphometric studies OR morphometry OR morphomet* OR volumetric studies OR volumetry OR volumet*	109	93037	27538	120684
Non-Bayesian Between-Subjects Statistics	non-bayesian statistics OR non-bayes* OR parametric statistics OR param* stat* OR non-parametric statistics OR non-param* stat* OR independent t-test OR one-way ANOVA OR one-factor ANOVA OR Pearson product moment correlation OR point biserial correlation OR Mann–Whitney U test OR Kruskal-Wallis H test	7742	129423	54028	191193
Combination of Themes	(anatomy OR anatom* OR human anatomy OR human anatom* OR comparative anatomy OR compar* anat* OR physical anthropology OR anthropology OR phys* anthr*) AND (Talus OR astragalus OR astragal OR ankle OR bone ankle bone) AND (morphometric studies OR morphometry OR morphomet* OR volumetric studies OR volumetry OR volumet*) AND (non-bayesian statistics OR non-bayes* OR parametric statistics OR param* stat* OR non-parametric statistics OR non-param* stat* OR independent t-test OR one-way ANOVA OR one-factor ANOVA OR Pearson product moment correlation OR point biserial correlation OR Mann–Whitney U test OR Kruskal-Wallis H test)	4	0	57440 †	57444
Total		9310	306842	178813	494965

Date of the Review of Literature: 13th-16th of September 2019.

†Irrelevant Hits [Keywords Non-Sensitive Search]

Table 1B: Systematic Review of the Literature: Highest Level-of-Evidence Studies.

Title of Research	Date of Publication	Number of Authors	Country of Research [Database]	Database of Literature	Topic of Research	Study Design
Rehabilitation for ankle fractures in adults [http]	2012	6	Australia	The Cochrane Library	Ankle Fractures	Systematic Review
Compression stockings for the initial treatment of varicose veins in patients without venous ulceration [http]	2013	4	United Kingdom	The Cochrane Library	Varicose Veins †	Systematic Review
Balneotherapy for chronic venous insufficiency [http]	2019	4	Brazil	The Cochrane Library	Chronic Venous Insufficiency †	Systematic Review
Interventions for vitiligo [http]	2015	8	United Kingdom	The Cochrane Library	Vitiligo †	Systematic Review

† Irrelevant Hits [Keywords Non-Sensitive Search]

An Amalgamation of Biotechnology Experiments and Multi-Modal Non-Bayesian Statistics

To achieve high computational precision and statistical accuracy in terms of sensitivity-specificity and predictive values, we shall conduct three modalities of biotechnology experiments to calculate the volume of the dry talus bone specimens that belong to both lower limbs, right and left. These include deploying the use of alginate-based cast materials, silicone-based cast replica manufacturing of the talus bone, as well as the implementation of Archimedes fluid displacement method for Volumetry [5]. To conclude with a rigour statistical inference on the right versus left tali comparison, we shall implement a plethora of non-Bayesian models of statistics for between-subjects testing, including Fisher's one-factorial ANOVA, William's independent t-test, and Pearson's product-moment correlation [in case of non-violation of normality and other parametric tests assumptions] (Figure 1) [12]. In case of violation of normality and parametric tests assumptions, we aim to achieve statistical extrapolation by using Point-Biserial correlation, Mann-Whitney U test, and Kruskal-Wallis H test. To assess the normality distribution of data, we shall implement either the Shapiro-Wilk test or Kolmogorov-Smirnov test. The goal of the multitude of triple-mode biotechnology experiments and the pre-planned octa-model statistical testing, is to accomplish a replicable study that is internally and externally-valid as well as being statistically robust with the least possible statistical errors [type-1 (α) and type-2 (β) errors] [13-15].

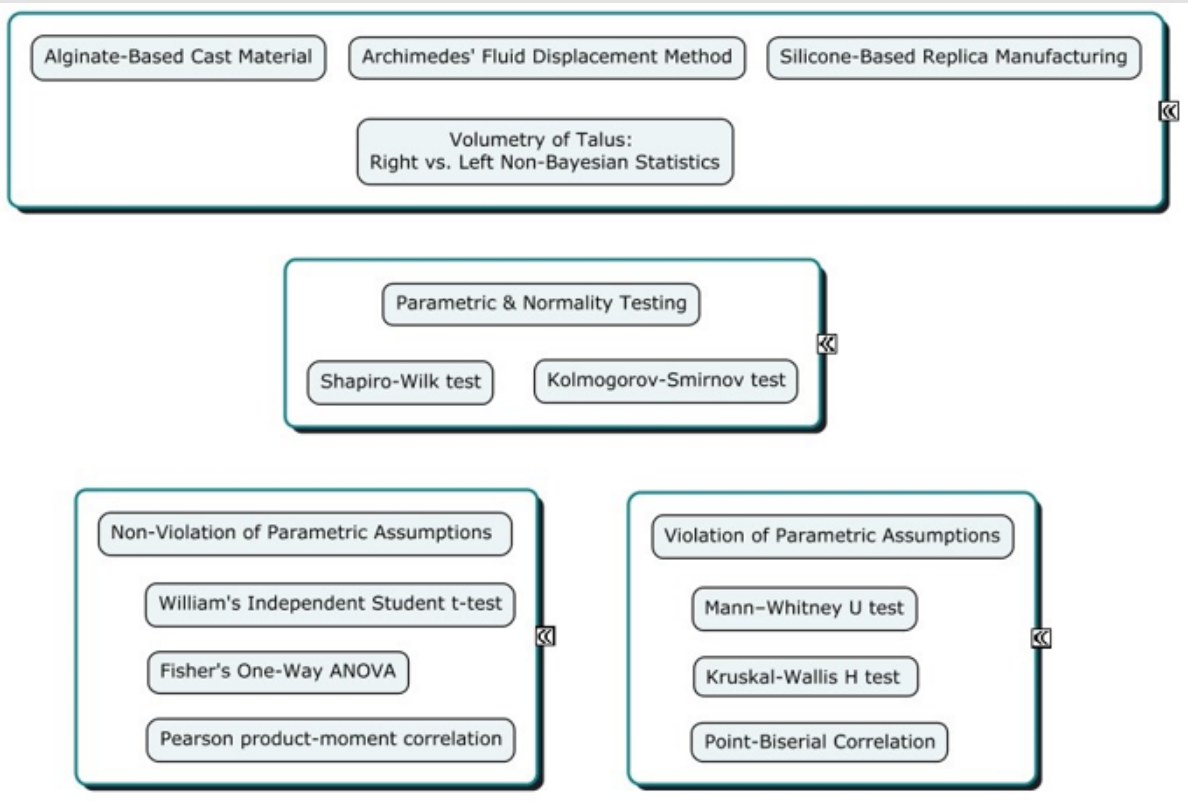

Figure 1: Volumetric Study Workflow: Quadri-Nodal and Tri-Hierarchical Concept Map.

High-Precision Multi-Modal Methodology for High-Impact Future Research

High-impact anatomy researchers should aim for replicable and externally valid results of the talus bone morphometry [13,16]. We recommend a stepwise hierarchical approach to pragmatically

a. Conduct a systematic review of the databases of literature in connection with the primary objective, including relevant publications on the historical as well as the scientific aspects of the anklebone morphometry and its applied as well as clinical applications.

b. Optimize the systematic review of literature by deploying non-human mediated automated retrieval of publications of interest and the corresponding indexing data in real-time from the gold-standard established databases of the published literature in addition to the unpublished "grey" literature [17]. This step will require the implementation of high-level programming languages including MATLAB and Octave as well as spreadsheet templates and professional statistical packages for social sciences including SPSS, Stata, and Microsoft Excel with Data Analysis Tool Pak [18].

c. Create analytics based on the systematic review of literature in an attempt to discover a deficit that may portray some degree of statistical imprecision of the published literature.

d. Retrieve collateral data from online resources of interest, including Google Trends and Google Analytics open-source of big data.

e. Conduct multimodal biotechnology experimentation for morphometry of dry tali specimens.

f. Experiment with a hybrid of non-Bayesian statistical methods, including parametric and non-parametric models of hypothesis testing, in an aim to compute the talus volume and to infer an extrapolation for populations of interests.

g. Correlate the data with applied knowledge and clinically oriented applications in connection with musculoskeletal medicine, orthopedic surgery, rheumatology, and microvascular surgical specialties [19].

h. Disseminate the hierarchical knowledge by communicating collaborative and evidence-based knowledge with health organizations and global regulatory agencies of medical and research practice, thus aiming for a universal dissemination of unbiased information.

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