



Article

The Pretoria Bone Collection: A 21st Century Skeletal Collection in South Africa

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Abstract: The Pretoria Bone Collection (PBC) began in 1942 with the opening of a medical school at the University of Pretoria (UP) in Pretoria, South Africa, where this skeletal collection is housed in the Department of Anatomy. The purpose of this paper is to provide information on the national legislation associated with obtaining, curating and researching skeletal remains in South Africa, the demographic composition of the PBC, and the inclusion of a portion of these remains into a digital repository known as *Bakeng se Afrika* (BsA). The PBC comprises 873 complete skeletons, 344 complete postcrania without crania, and 308 complete crania without postcrania. Skeletal contents are reflective of the population statistics of South Africa, with a smaller proportion of White (32%) than Black (65%) South Africans. Unlike the population profile, males in the PBC are greater in number (75.5%) than females (24.5%), which may be explained by the number of migrant labourers traveling into a large city such as Pretoria. From this sample, crania (206), maxillae (141), mandibulae (408), femora (137), and radii (134), as well as several other skeletal elements were micro-XCT scanned and are available on the BsA server. A researcher needs to submit an online application to the Human Research Ethics Committee (HREC) of the Faculty of Health Sciences at the University of Pretoria for access to these collections.

Keywords: skeletal collections; digital repository; legislation; whole body donation; biological anthropology; cadavers



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1. Introduction

Worldwide, human skeletal collections have provided medical and healthcare practitioners as well as biological anthropologists with knowledge of skeletal anatomy, human variation, disease, and trauma. National legislation around the acquisition, display and use of human skeletal remains varies considerably, and ethical principles pertaining to the public and private use of human bone are continuously debated within varying socio-cultural and socio-political landscapes.

Rapid advancement in digital technology provides opportunities for the creation of digital skeletal repositories of the living and the dead for the purposes of research and education. Large digital samples of human skeletons can be used to expand our understanding of skeletal variation and ultimately its application to both medical and medicolegal disciplines. For example, the current use of three-dimensional (3D) models and prints in pre-operative surgical planning is a paradigmatic shift in medical practice that opens up novel spaces for the development of digital planning teams in healthcare as well as data sharing and transdisciplinary collaboration amongst researchers, educators and institutions on a global scale [1].

Despite worldwide globalization during the 21st century, many inequalities in healthcare, resources (e.g., food and water) and education persist between developed nations such as the United States (USA) and countries in Europe and developing countries such as South Africa. Researchers working on healthcare advancements in first world countries

may be reliant on human subjects from the third world, leaving an inequitable gap in the benefits of research between developed and developing nations and their citizens. For instance, in the late 19th and early 20th century, skeletons and body parts from South Africa were sought by researchers and collectors in Europe. Indigenous South Africans, both Khoi and San, were exhumed, transported to several European museums and have never been returned to their birth country [2].

The unequal power relationships between and among nations forms the basis for current legislation and ethical considerations in South Africa around the donation of human bodies to medical schools, the curation of these remains, and the accessibility of these skeletons (digital or biological) to national and international researchers and educators [3].

Human skeletal collections were used in South Africa for medical education and research as early as 1919 with the creation of the Department of Anatomy (now the School of Anatomical Sciences) at the Medical School of the Witwatersrand University (WITS) in Johannesburg, South Africa [4]. The Department used dissection room cadavers for the purpose of training medical students in structural and morphological anatomy and osteology. Once gross anatomy dissection was completed, the cadavers were further macerated and processed into skeletons, which were then catalogued into the Raymond A. Dart Skeletal Collection along with known demographic information [4]. Today, the collection contains approximately 2022 individuals, of whom the majority are Black South African males [4].

In 1942, the University of Pretoria (UP) in Pretoria, South Africa opened a medical school on their Prinshof Campus. Similar to WITS, dissection room cadavers were required for training medical students in structural and morphological gross anatomy in the Department of Anatomy. After dissection, the human remains were macerated and processed into skeletal elements for the purpose of training medical, dental and healthcare students in human osteology. In the 1990s, these human skeletons were organized into a research collection known as the Pretoria Bone Collection (PBC), in which all catalogued skeletons had known demographic information [5]. Similar to the Raymond A. Dart collection, the majority of the PBC sample is comprised of Black South African males [4,5].

Since 2018, as part of a collaborative Erasmus+ capacity-building project in higher education (CBHE) from the European Union (EU) known as *Bakeng se Afrika* (BsA), a portion of the PBC, along with portions of the Human Skeletal Collection at the Sefako Makgatho Health Sciences University (SMU) in Pretoria North, South Africa, and the Kirsten Skeletal Collection at the Stellenbosch University (SUN) in Stellenbosch, South Africa [6], was scanned using micro-focus X-ray Computed Tomography (micro-XCT) at the South African Nuclear Energy Corporation (Necsa). This collaborative project aims to develop a digital repository of frequently used skeletal elements, namely the cranium, maxilla, mandible, femur and radius, from these three medical schools. Skeletal elements scanned for specific research projects will also be included in the digital repository. The repository is to be housed and maintained at UP. Ongoing expansion of the biological PBC collection at UP will parallel expansion of the BsA digital repository, with a focus on adding data from 3D surface scans, bone trauma, and pathology as well as anonymized Computed Tomography (CT), Cone Beam Computed Tomography (CBCT) and Magnetic Resonance Imaging (MRI) scans of living patients from the neighbouring hospitals, which had been used in prior research.

With the increased popularity of the creation of digital data and of the sharing of digital data in research, education and medical practice worldwide, researchers need to understand the South African legislation associated with the ethical use of human skeletal material, both biological and digital, in the country. The purpose of this paper is to provide information on the current national legislation associated with the acquisition, housing and researching of skeletal remains in South Africa, to outline the composition of the PBC, and to highlight the contribution of this bone collection to the BsA digital repository. The requirements on how to access the PBC and the BsA digital repository are also provided.

2. South African Legislation around Skeletal Remains

The National Health Act 61 of 2003 [7] addresses all frameworks within the national health care structures and services within the Republic of South Africa. Of interest to the PBC is the legal acquisition of cadavers and their associated skeletons at medical schools within higher education institutions (HEIs).

Chapter 8, Sections 62 and 64, of the National Health Act (NHA) 61 of 2003 [7], states that a person can wilfully donate their body to a medical school (the designated institution) of their choice in their will, or they may be donated by their relatives. Alternatively, if a person dies destitute in a hospital and the next of kin cannot be found within a reasonable time (generally 48 h), then the Director General, with approval from the inspector of Anatomy, may donate the remains to the nearest medical school. All donated human bodies are embalmed upon arriving at their respective medical facility. While not specified within the NHA, a moratorium of one year is often placed on the body of an unclaimed person prior to their entering the dissection hall, so as to provide time for the person to be claimed by family members.

The deceased, whether wilfully donated or donated by the Director General, enters the 'Whole Body Donation Programme' at one of the medical schools in the country. Whole body donations fall under broad consent, which means that a body (and its associated data) can be used for tissue transplantation or research and education now and into the future. The future is a broad clause that includes advancement in technology such as virtual copies of the deceased's skeleton, organs and soft tissues via scanning, reconstruction of scanned images, and 3D prints. In order to use a whole-body donor or their skeleton in research, the researchers need to apply to the Human Research Ethics Committee (HREC) [7] at the institution in which the body is stored and curated. The researcher does not need permission from the individual donor or their family. All skeletal remains in the PBC were either wilfully donated or donated via the Director General to the medical school at the University of Pretoria.

In addition to the NHA, the National Heritage Resources Act (Act 25 of 1999) (NHRA) [8] is used to safeguard archaeological skeletons, or skeletal remains older than 60 years [8]. This act was promulgated to ensure the management and preservation of any object and structure deemed to have heritage significance for any community within South Africa. The NHRA ensures the ethical acquisition of human remains that may later be housed in archaeological collections around South Africa, either in medical schools or designated museums. Any activity that affects human remains that falls under the ambit of the NHRA cannot be conducted without a South African Heritage Resources Agency (SAHRA) permit. Any party interested in researching archaeological skeletons must follow the regulation stipulated in Sections 35 and 36 of the NHRA [8]. Scientific studies that are conducted on any archaeological remains require a SAHRA permit, whether non-intrusive or intrusive. Consultation with affected local communities is one of the key components of NHRA and seeks to empower communities to uphold and protect their heritage rights, particularly around the cultural norms and practices involving human remains. The same deference is used to mitigate the use of unclaimed bodies indirectly donated to medical schools in South Africa, as these skeletal remains are directly associated with living South African communities.

The NHRA refers specifically to skeletal remains inadvertently uncovered during construction work and/or the removal of known historical burials with known heritage significance. No overlap exists between the NHA and the NHRA, such that the NHRA does not apply to skeletal remains of an unclaimed person in a bone collection at a medical school that has been housed for more than 60 years.

3. Composition of the Pretoria Bone Collection

In the last 300 years, colonialism, slavery and *apartheid* contributed to the development of social groups in South Africa. From 1913 to 1983, at least 60 segregation Acts concerning race, employment, education, land tenure and geography, marriage, political representation, and state security were implemented to control and to govern the *apartheid* regime. Social

classifications of populations were defined during the *apartheid* era and the terminology was retained after the democratically elected government for the purposes of redress. The early 1950s saw the Population Registration Act No. 30, which empowered the 1951 census bureau to classify every South African into four groups: “Native/Bantu” (Black); Coloured, White, and Asian. The social designation of Coloured refers to a highly admixed group of people, primarily from the Western Cape, that are comprised of influences from indigenous Khoikhoi and San, Asian, European, and slaves from various African and non-African countries [9,10].

South Africa contains approximately 60.1 million people who are self-classified into four major socially defined groups, primarily Black South Africans (80.9%), Coloured South Africans (8.8%), White South Africans (7.7%) and Asian/Indian South Africans (2.7%) (Statistics South Africa, 2021) [11].

All skeletal remains within the PBC have dates of birth and death within the 20th and 21st century and have known demographic information, including sex, age, population affinity, approximate height and weight, and cause of death. Cadavers originate from donations and unclaimed bodies in local hospital settings in the City of Tshwane Metropolitan Municipality, of which Pretoria is a part, and includes hospitals such as the Steve Biko Academic Hospital and the Kalafong Provincial Tertiary Hospital.

The contents of the PBC are shown in Table 1. The majority of the collection is comprised of Black ($n = 862$) and White South African males ($n = 296$). Age at death ranges from 4 to 99 years, with the average age at death being lower for Black (47 to 54 years) than White South Africans (69 to 73 years). Overall, females are under-represented in both population groups and all individuals are of lower socio-economic status [5,12]. Females, particularly Black South African females, do not or are not donated to medical schools as often as males. In Gauteng, whole body donations are often based on the socio-economic circumstances of the surviving family and their concerns around funeral and burial costs. The entire collection, when sex and population affinity are combined, comprises 873 complete skeletons, 344 complete postcrania without crania, and 308 crania without postcrania. The available sample sizes have been shown to be suitable for osteometric and morphological analyses of South African groups [5,13–15].

Table 1. Composition of the Pretoria Bone Collection separated by population affinity and sex.

Elements	Black South African Males	Black South African Females	White South African Males	White South African Females
Complete skeletons	434	76	212	151
Postcrania only	238	51	27	28
Crania * only	192	36	57	23
Total	864	163	296	202
Average age (years)	54.2	47.3	69.9	73.5
Age range (years)	4–98	13–82	31–99	21–97

* with or without mandibles; may be edentulous, have partial or complete dentition. For instance, 103 individuals are fully edentulous (maxilla and mandible) and are over represented in White South Africans.

4. Bakeng se Afrika Digital Repository

The BsA digital repository is a collaborative project between four national (South African) and four international institutions: UP (the coordinating institution), SMU, SUN, Necs, the Université de Bordeaux (UB, France), the Universidade de Coimbra (UC, Portugal), the Katholieke Universiteit Leuven (KUL, Belgium) and the Centre National de la Recherche Scientifique (CNRS, France).

The micro-XCT scan data was generated through a collective team of equipment and medical scientists (physicists, anthropologists, anatomists, dentists, etc.). The skeletal material was scanned at high resolution in the Micro-Focus X-ray Radiography and Tomography facility (MIXRAD) at Necs using a Nikon XTH 225 ST industrial Computed Tomography system (Nikon Metrology, Belgium). More details about the equipment can be found in Hoffman and De Beer (2012) [16] and De Beer (2018) [17]. For each skeletal

element, namely the cranium, maxilla, mandible, radius, and femur, the best scanning parameters were selected according to the size and the density of the bone. During each acquisition, a stack of two-dimensional (2D) radiographic projections was created and was reconstructed into a three-dimensional (3D) volume using the in-house Nikon CT-Pro 3D software (Nikon Metrology, Belgium). The reconstruction was done following optimised transformation parameters adjusted to each skeletal element. The original stack of radiographic projections as well as the reconstructed volume of the bones were saved and stored on a physical server, which is housed and maintained at UP. Backups of the data are also stored in a separate space within the UP system. A web-based platform will be created for interested researchers to access selected metadata through a user-friendly portal, with a projected availability of November 2022. A set of standard procedures and quality assurance guidelines ensure that the data is fit for use in research. Guidelines and procedures will be available on the portal.

In Table 2, all the skeletal elements from the PBC that were micro-XCT scanned for the BsA repository are shown, separated into population affinity and sex. The most frequently scanned skeletal elements were the cranium, maxilla, mandible, radius and femur, with a relatively equal distribution of males and females. The BsA repository will also include skeletal elements that were scanned for specific research projects, such as focus on the dentition, vertebral column, humeri, hands, os coxae, patellae and feet. Digital data increases data accessibility for researchers and broadens the application of osteological research to the health professions disciplines, such as the designing of population-specific prosthetics in dentistry and orthopaedics.

Table 2. Skeletal elements from the Pretoria Bone Collection that were micro-XCT scanned for inclusion in the *Bakeng se Afrika* skeletal repository, separated by population affinity and sex.

Elements	N Bones	Total N Individuals	Black South African		White South African	
			Male	Female	Male	Female
Skull and Dentition						
Cranium	206	206	50	59	48	49
Mandible	408	408	173	75	89	71
Maxilla	141	141	26	51	28	36
Focus on dentition (Mandible/Maxilla)	35	35	30	3	2	0
Postcranial skeleton						
Vertebral Column *	-	10	2	3	2	3
Humerus	13	13	2	4	4	3
Focus on humerus †,‡	-	21	5	6	6	4
Radius	134	134	33	32	41	28
Hands §	-	19	5	5	4	5
Os coxae †	38	30	7	8	8	7
Femur	137	137	33	38	36	30
Focus on femur †,‡	-	67	22	13	17	15
Patella †	27	16	4	5	3	4
Feet ¶	-	23	7	6	5	5

* cervical, thoracic and lumbar vertebrae were scanned. † only proximal and/or distal parts were scanned. ‡ for some individuals, left AND right bones scanned. § 9 individuals with phalanges, metacarpals and capitate scanned; 10 with capitate only ¶ 11 individuals with metatarsals, calcaneus and talus scanned; 12 with calcaneus only.

5. Discussion/Conclusions

Since its inception in 1990, numerous national and international researchers have utilised the PBC [5]. The population affinity, sex and age distribution of skeletons within the PBC is directly associated with the socio-political and socio-cultural landscape of South Africa. Due to socio-cultural norms and practices, the majority of Black South Africans do not wilfully donate their bodies or skeletal remains to medical schools for scientific

inquiry. Therefore, the skeletal remains associated with this population are most likely from unclaimed persons, particularly migrant labourers.

From the 1900s to present day, the Gauteng province, which includes Johannesburg and Pretoria, has seen an influx of migrant labourers to work in the mines and other industries. Between 2016 and 2021, the Gauteng Province received 1,564,861 migrants, which is the most of all nine provinces in the country [11]. Most of the migrant mine labourers entering Gauteng, both in the past and at present, are Black South Africans and/or foreign nationals from neighbouring countries such as Zimbabwe, Botswana, Zambia, and Mozambique. Separated from their families, many of these labourers died unclaimed in public hospitals and their bodies have been donated by the Director General, as specified under both the Human Tissues Act of 1983 [18] and the NHA [7], from the government hospitals to the closest medical schools. Family members or friends can claim a person at any time, provided they can prove a relationship with the deceased or a letter from the magistrate [6]. From the PBC, approximately 4 percent of unclaimed persons and/or their skeletons have been repatriated to relatives [5].

Numerous challenges exist with the indirect informed consent of the Director General for the use of unclaimed bodies into the medical school systems of South Africa. Due to ethical concerns, medical schools in South Africa are no longer accepting unclaimed persons into their whole-body donation programme. No clarity has been provided within the medical community in South Africa as to how to address the ethics of unclaimed skeletons that are currently being used for education and research.

Advancements in digital imaging technology is an opportunity for the global application of biological anthropology. Data sharing is aligned with building capacity in research and education in developing countries, in attracting high quality and diverse postgraduate students to research programs, in improving success in international research grants, in validating research methodology, and in applying outcomes to both the medicolegal and health-related fields. Yet, who stands to benefit from this advancement in data acquisition and research outcomes? The donors, the researchers, or the society in which the data is contextualised? The potential for the abuse of digital data worldwide, as well as the vulnerabilities of developing countries, need to be considered. While considerations should not prevent data sharing or collaboration, better guidelines for accountability for ethics violations need to be established. Some areas for investigation include issues of consent, donor perceptions of the use of their body in a digital afterlife, and ownership/intellectual property (IP) of 3D reconstructions and prints of a skeleton.

With this said, the use of digital images of skeletal remains, which do not represent biological material, and 3D prints of bone in medical education is a possible approach to address these ethical concerns; however, no studies have been created to evaluate public opinion on 3D prints in South Africa. Additionally, ethical approval from a South African institution is required for all national and international researchers requesting to use the PBC or the BsA repository in their research.

The National Health Act 61 of 2003 in section 72(3) [7], stipulates that any researcher who wants to access data on humans, living or deceased, needs to apply for approval through a human research ethics committee at the institution, which is housing, maintaining and storing those remains. For access to and use of the PBC and the BsA repository, a researcher needs to submit an online application to the Research Ethics Committee (REC) of the Faculty of Health Sciences at the University of Pretoria (<https://www.up.ac.za/healthethics> (accessed on 7 December 2021)). The guidelines of the REC are aligned with the Department of Health Guidelines (DOH) for Ethics in Research, the NHA, and the POPI Act of 2013 [19]. A research proposal is required from the applicant and the following stipulations need to be met in the application and attached documents:

- Verification of applicant/supervisors/principle/institution (in form of a letter);
- All projects prior to submission to the research ethics committee (REC) at the UP will be peer-reviewed within the Forensic Anthropology Research Centre for adherence to good practice;

- At least one of the principal investigators must be a South African citizen for the purposes of accountability of ethics regulations;
- Research proposals not associated with employees or students of the University of Pretoria will require a fee for processing at the REC or UP. This is in accordance with the Department of Health (DOH) for Ethics in Research in South Africa and is applicable at all institutions in the country;
- All researchers need to acknowledge the BsA repository in their published outputs and science communication efforts;
- For digital data, all researchers enter into a digital utilization agreement in which they agree to not: share the data with other parties (Digital Object Identifiers, DOIs, will be attributed and will serve as reference of raw data for reproducibility), create commercial use of the data or derivatives of the data; and to maintain anonymity of the data while it is in their possession;
- For digital data, researchers need to upload their project and any associated outputs to the BsA researcher's database.

Since 2005, the PBC has grown considerably in size. With many researchers accessing the collections, both at the national and the international level, it is important to discuss legislation and ethical access to both biological and digital resources. Large datasets of high-definition digital 3D models of skulls or other anatomical structures and their associated metadata are valuable for Artificial Intelligence (AI) training, particularly for 3D Convolutional Neural Networks, which may be valuable in estimating biological profiles and health related-issues from bone, particularly when researchers are provided with sufficient amounts of data and corresponding metadata [20].

Future research needs to focus on proper curation of digital data to avoid abuse and deterioration. As researchers, we need to engage in the accurate preservation of data for all researchers, educators, donors and future generations.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki. Ethical approval for the BsA repository was obtained from the Research Ethics Committee of the Faculty of Health Sciences of the University of Pretoria (protocol 619/2021).

Informed Consent Statement: Broad consent which stipulates that a donated body can be used for research and education now and into the future is part of the whole-body donation programmes at medical schools in South Africa, and is aligned with the NHA of 2003.

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References

1. Vaz, V.M.; Kumar, L. 3D Printing as a Promising Tool in Personalized Medicine. *AAPS Pharm. Sci. Tech.* **2021**, *22*, 49. [[CrossRef](#)]
2. Morris, A.G. The Reflection of the Collector: San and Khoi Skeletons in Museum Collections. *S. Afr. Archaeol. Bull.* **1987**, *42*, 12–22. [[CrossRef](#)]
3. Ethics in Health Research. Principles, Processes and Structures. Second Edition. Department of Health. Republic of South Africa. 2015. Available online: <https://www.sun.ac.za/english/research-innovation/Research-development/Documents/Integrity%20and%20Ethics/DoH%202015%20Ethics%20in%20Health%20Research%20%20Principles,%20Processes%20and%20Structures%202nd%20Ed.pdf> (accessed on 21 November 2021).
4. Dayal, M.R.; Kegley, A.D.; Strkalj, G.; Bidmos, M.A.; Kuykendall, K.L. The history and composition of the Raymond A. Dart Collection of Human Skeletons at the University of the Witwatersrand, Johannesburg, South Africa. *Am. J. Phys. Anthropol.* **2009**, *140*, 324–335. [[CrossRef](#)]
5. L'Abbé, E.N.; Loots, M.; Meiring, J. The Pretoria Bone Collection: A modern South African skeletal sample. *HOMO J. Comp. Hum. Biol.* **2005**, *56*, 197–205. [[CrossRef](#)]
6. Alblas, A.; Greyling, L.M.; Geldenhuys, E.-M. Composition of the Kirsten Skeletal Collection at Stellenbosch University. *S. Afr. J. Sci.* **2018**, *114*, 6. [[CrossRef](#)]
7. Republic of South Africa. National Health Act (Act 61 of 2003). Available online: www.info.gov.za/gazette/acts/2003/a61-03.pdf (accessed on 31 October 2021).
8. Republic of South Africa. National Heritage Resources Act (No 25 of 1999). Available online: <https://www.gov.za/documents/national-heritage-resources-act> (accessed on 31 October 2021).
9. Adhikari, M. Contending approaches to colored identity and the history of the colored people of South Africa. *Hist. Compass* **2005**, *3*, 1–6. [[CrossRef](#)]
10. Long, J.C.; Li, J.; Healy, M.E. Human DNA sequences: More variation and less race. *Am. J. Phys. Anthropol.* **2009**, *139*, 23–34. [[CrossRef](#)]
11. Statistics South Africa. 2021. Available online: <http://www.statssa.gov.za/publications/P0302/P03022021.pdf> (accessed on 15 November 2021).
12. L'Abbé, E.; Van Rooyen, C.; Nawrocki, S.; Becker, P. An evaluation of non-metric cranial traits used to estimate ancestry in a South African sample. *Forensic Sci. Int.* **2011**, *209*, 195.e1–195.e7. [[CrossRef](#)] [[PubMed](#)]
13. Liebenberg, L.; L'Abbé, E.N.; Stull, K. Population differences in the postcrania of modern South Africans and the implications for ancestry estimation. *Forensic Sci. Int.* **2015**, *257*, 522–529. [[CrossRef](#)]
14. L'Abbé, E.N.; Kenyhercz, M.; Stull, K.; Keough, N.; Nawrocki, S. Application of Fordisc 3.0 to Explore Differences Among Crania of North American and South African Blacks and Whites. *J. Forensic Sci.* **2013**, *58*, 1579–1583. [[CrossRef](#)] [[PubMed](#)]
15. Krüger, G.C.; L'Abbé, E.N.; Stull, K.E.; Kenyhercz, M.W. Sexual dimorphism in cranial morphology among modern South Africans. *Int. J. Leg. Med.* **2015**, *129*, 869–875. [[CrossRef](#)]
16. Hoffman, J.W.; De Beer, F.C. Characteristics of the micro-focus X-ray tomography facility (MIXRAD) at Necsa in South Africa. In Proceedings of the 18th World Conference on Non-Destructive Testing, Durban, South Africa, 16–20 April 2012.
17. De Beer, F.C. Neutron and X-ray Tomography as Research Tools for Applied Research in South Africa. Ph.D. Thesis, North-West University, Potchefstroom, South Africa, 2018.
18. Republic of South Africa. Human Tissue Act 65 of 1983. Available online: <http://www.kznhealth.gov.za/humantissuesact.pdf> (accessed on 31 October 2021).
19. Republic of South Africa. Protection of Personal Information Act No 4. Government Gazette 581(37067). 2013. Available online: <https://www.gov.za/documents/protection-personal-information-act> (accessed on 23 November 2021).
20. Thurzo, A.; Kosnáčová, H.S.; Kurilová, V.; Kosmel', S.; Beňuš, R.; Moravanský, N.; Kováč, P.; Kuracinová, K.M.; Palkovič, M.; Varga, I. Use of Advanced Artificial Intelligence in Forensic Medicine, Forensic Anthropology and Clinical Anatomy. *Healthcare* **2021**, *9*, 1545. [[CrossRef](#)] [[PubMed](#)]