Optimization of Histological Specimen Preparation with Digital Image Localization Analysis

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Background: The periosteum, endosteum, bone marrow, and other overlying tissues play a significant role in the process of healing and bone regeneration. Presently removing overlying tissues is one of the main methods used to locate a specific region of interest (ROI) in experimental healing models to study the histological perspective. If we remove the overlying tissues, we may be losing relevant data collected from the overlying tissues' role in the regeneration/ healing process.

Aim: This study aims to achieve a higher accuracy rate of histology sectioning of the specific ROI without removing the overlying soft tissues utilizing the cone-beam computed tomography (CBCT) analysis.

Material and Methods: In this study, 55 fixed rats' tibia were transferred into the 50ml Falcon tube with stoppers to fix the location of the tibia in the container. Identification of four surgically created defects located on the tibia from each surgical group was analyzed by following the CBCT series.



Figure 1: Materials and methods used:

A. Primary CBCT with "Assumed" location of ROI B. Interpretation of Rotation on the CBCT Software (InVivo6). C. Rotation device to translate rotation data D. Displaying the XYZ plane relevance to tibia sample

Results: The CBCT1 is the representative of variance from the manually un-assisted initial reference before CBCT analysis, where 0.00 represents the accuracy of no additional rotation to locate the ROI, and any number other than 0.00 shows a deviation from the "assumed" site to the relative location of the ROI. CBCT2 represent the accuracy-related to the use of digitally guided image analysis via CBCT, to determine the ROI's location. Five samples needed an additional CBCT2 due to human error and were corrected. The accuracy of CBCT1 and CBCT2 is, 1.8% and 98.2% respectively.

Accuracy of digitally guided analysis method to identify ROI



*Re-assess the location of ROI, if it is not accurate

Statistics			
		CBCT1	CBCT2
Ν	Valid	55	55
	Missing	0	0
Mean		6.8618	1982
Median		5.0000	.0000
Mode		14.10 ^a	.00
Std. Deviation		15.24142	1.46976
Variance		232.301	2.160
Skewness		.602	-7.416
Std. Error of Skewness		.322	.322
Range		81.30	10.90
Minimum		-25.70	-10.90
Maximum		55.60	.00
Percentiles	25	-5.6000	.0000
	50	5.0000	.0000
	75	19.0000	.0000





CBCT2 Angle Rotation Analysis from the confirmed reference line



Figure 3: Graphical representation of CBCT to determine the ROI:

The negative values represent rotation to the Left and positive values is to Right and Zero representing the correct region with no rotation, 1. CBCT1 showing deviation in degrees from assumed ROI represented by the red line. 2. CBCT2 showing the accuracy related to CBCT analysis of confirmed ROI, represented by the blue line.

Conclusion: The application of a digitally guided image analysis determines the precise location of the ROI displayed as a higher rate of accuracy in preparing the specimens for histological sectioning.

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