Spiral Computed Tomography (SCT) study to validate Digital Radiographic Imaging (DRI) in C*anis lupus* skulls from Italian south-central Apennines.

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Abstract - A DRI examination was performed on two unscarified wolf skulls. 14 craniometrical parameters were measured on DR images. The measures were compared with the same parameters obtained by (SCT) imaging, to evaluate Radiographic Magnification (RM). DRI and SCT imaging measures didn't statistically differ. Mean and SD of differences were 1.17 ± 0,83 mm, comparable to calliper usual technique. Digital Radiographic Imaging (DRI) appears a valuable method of measurement of craniometrical skulls parameters, suitable in wild *Canis lupus* in vivo too.

Key words - Wolf Skull, Spiral CT, Radiographic Magnification

Introduction - The craniometrical studies in wolf are usually carried out by measurements with callipers to nearest 0,1 - 1 mm, on old skulls stored in museum collection (Okarma H.,1993; Andersone Z.,2000; Siracusa AM.,2004). This technique is not suitable for studies in vivo or on unscarified skulls, for obvious reasons. Studies in vivo should give the advantage to get real time craniometrical information on a subject, without doubts about sex, age and geographical origin. Changes in skull morphology could be demonstrated studying a living population and comparing the measures with museum skulls collections. Digital Radiographic Imaging (DRI) Size Estimation should be accurate, so as traditional craniometrical studies, if depurate from described Magnification Error (Carpenter CM. 2008), that is less significant in anatomical region of small size (Paul L. 2008).

In addition, plain DRI is not time spending and easy to perform, also in anaesthetized animals, on field conditions (Thrall D.E., 2002). For this reasons, DRI could represent a valid alternative to more sophisticated RM free imaging techniques, as Computed Tomography. We utilized SCT to evaluate RM in digital plain radiographic studies, with the aim to validate DRI craniometrical measurements in vivo and compare this method with traditional calliper technique on scarified skull.

Materials and methods - Two unscarified skulls from wolves, died by car accident in Abruzzo Region, were examinated by SCT (slides 3 mm) and DRI in D-V and L-L projection. On each skull, were measured 14 parameters (Tab 1), commonly reported in literature (Okarma H.,1993; Endo H.,1997; Andersone Z. 2000; Siracusa AM. 2004).Landmarks were recognized on DRI and SCT and the parameters were measured respectively with Lifeweb One Ferrania and Volwiew 3.0 softwares. The data group DRI and SCT were divided in transversal (tDRI and tSCT Subgroups) and sagittal (sDRI and sSCT Subgroups) parameters subgroups too. The measures of the DRI Group were compared with the SCT Group by Unpaired t test e One Way Anova test (P<0,05) (software GraphPad Instat). The same statistical analysis was performed to compare the parameters of the transversal and sagittal subgroups (tDRI vs tSCT and sDRI vs sSCT).

Tab 1 - Transversal parameters (Gr.T)	
ZyB	Maximum zygomatic width.
MB	Maximum mastoid breadth.
LB	Minimum width of the skull. Minimum width of the processes above aboral orbital.
EntB	Minimum width between the orbits.
C^{1}Br	Width between the inner margins of the alveolus of the lower canines.
C^{1}B	Width between alveoli of the upper canines.
SH	Height of the skull.
Sagittal parameters (Gr.S)	
ToL	Total length, measured between prosthion and sagittal crest.
MNaL	Nasal maximum length.
MdL	Total length of the jaw .
TRL	Length of the tooth above the roots, measured from the anterior margin of P^1 to posterior edge of M^2
BaL	Baseline length between the edge of alveolus I1 to foramen supramastoideum.
CbL	Condilum basal length, measured between the edge aboral of occipital condilus and prosthion.
NaL	Nasal length, corresponds to the length of the joints between the nasal bones

Illustrazione 1: 3D view of cranium from Spiral TAC

Results - Anatomical landmarks were easily recognized by software in both imaging techniques. We calculated the difference between each parameters measured in groups DRI and SCT. The average value of this differences was 1,17 ± 0.83 mm. For groups tDRI and tSCT was 1.1 ± 0.78 and for sDRI and sSCT groups was 1.25 ± 0.88. Statistical analysis failed to demonstrate any significant differences between data of the two Groups and Subgroups.

Illustrazione 2: Latero- Lateral RX

Illustrazione 4: Dorso ventral RX

Illustrazione 3: Slides from Spiral TAC

Conclusions – DRI appears a suitable technique for measurement of craniometrical parameters of wolf skulls in vivo. This technique is easy to perform, inexpensive and accurate, compared to the accuracy of callipers, ranging from 0,1 to 1 mm (Okarma H., T. 1993, Andersone Z. 2000). Moreover, with DRI, we can eliminate the difficulties in positioning points on Repere, and variability of accuracy of the individual operator, that are very common with the classical techniques. DRI identification of landmarks is valuable and the radiographic magnification is negligible for wolf skull small size.

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