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Throat-Skeleton Fractures by Strangulation

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Summary. The frequency of throat-skeleton fractures was investigated in a series of 30 unselected cases of strangulation. Less than half of the victims showed fractures. From the data obtained, it seems to prove that there is a connection between the frequency of fractures and the age of the victims. The radiological investigation shows that this connection is based on the degree of ossification of the throat-skeleton. This ossification starts often already at early age and should be considered as a process of ageing. Notwithstanding the irregular occurrence of throat-skeleton fractures, these injuries are obviously of a vast diagnostic value.

Zusammenfassung. Die Häufigkeit von Kehlskelettbrüchen ist in einer Reihe von 30 unselektierten Fällen von Erdrosselung untersucht worden. Weniger als die Hälfte der Opfer wies Brüche auf. Aus den Untersuchungsergebnissen geht hervor, daß zwischen der Häufigkeit der Brüche und dem Alter der Opfer eine Beziehung besteht. Die Röntgenuntersuchung hat bewiesen, daß diese Beziehung auf den Verknöcherungsgrad der Kehlkopfknorpel zurückzuführen ist. Diese Verknöcherung beginnt öfters schon frühzeitig und muß als eine Alterungserscheinung angesehen werden. Obgleich Kehlskelettbrüche bei Erdrosselungen nicht regelmässig vorkommen, sind doch diese Verletzungen selbstverständlich von großem diagnostischen Wert.

Key word. Strangulation – Throat-skeleton fractures.

In judicial and police circles it is still often thought that strangulation causes a throat-skeleton fracture most of the time. We have examined the frequency of occurrence of fractures of the tongue-bone or/and of the larynx in 30 unselected cases of strangulation. Naturally we only deal with cases in which bleeding (a vital reaction) occured at the height of the fractures.

The anatomic examination of the throat-skeleton was made according to the technique recommended by Gordon, Turner and Price. (layer by layer dissection after removal of the brain and the heart). The creation of artefact lesions (post mortem fractures and haemorrhages) was thus avoided. In 27 cases of our series we also proceeded with a radiological examination of the separate anatomical preparation. Thomas and Kluyskens already pointed out the importance of X-ray examination in forensic medicine to detect injuries of the throat-skeleton. Table 1 represents the results obtained.

Table 1.

Numer of cases according to age group		Number of cases with fractures according to age group	
⟨ 40 years	40α ⟩ 40 years	⟨ 40 years	40α ⟩ 40 years
15 only ♀	15 {10♀ 5♂	3 (20%)	8 (53 %)
Total: 30		Total: 11 /36,66%)	

Table 2.

	Sex	Age	Fractures of tongue-bone and/or laryngeal-skeleton	
1	♀	17 years	none	a– ; b– (minimal)
2	♀	17	none	a++ ; b+
3	♀	17	none	a– ; b– (none)
4	♀	18	none	a– ; b+
5	♀	21	none	a– ; b+
6	♀	23	Fracture of the right cornu hyoïdeum of the thyroïd cartilage	a+ ; b+
7	♀	24	none	a– ; b– (minimal)
8	♀	24	none	a++ ; b– (minimal)
9	♀	25	none	a– ; b– (minimal)
10	♀	26	none	a– ; b+
11	♀	27	none	a+ ; b+
12	♀	28	Fracture of the right cornu hyoïdeum of the thyroïd cartilage	a++ ; b++ (local)
13	♀	28	none	a– ; b++ (local)
14	♀	31	none	a– ; b+
15	♀	37	Fracture of the right cornu maius of the tongue-bone	a++ ; b+
16	♀	40	Fracture of both cornua maiora of the tongue-bone	a++ ; b++ (diffuse)
17	♀	41	none	a– ; b++ (local)
18	♂	41	none	a++ ; b++ (diffuse)
19	♀	43	Fractures of the left cornu maius of the tongue-bone	a+ ; b++ (diffuse)
20	♂	50	Several fractures of the tongue-bone and of the thyroïd cartilage	a++ ; b+++ (diffuse)
21	♀	60	Fracture of the left cornu hyoïdeum of the thyroïd cartilage.	a++ ; b+++ (diffuse)
22	♂	60	none	a++ ; b++
23	♂	62	Fracture of the left cornu hyoïdeum of the thyroïd cartilage	a– ; b+++ (diffuse, also cricoïd cartilage)

Table 2. *(continued)*

24	♀	62	Fracture of both cornua hyoïdea of the thyroïd cartilage	a++ ; b++ (diffuse)
25	♀	72	none	a+ ; b++ (diffuse, also cricoïd cartilage)
26	♀	78	Fracture of the right cornu hyoïdeum of the thyroïd cartilage	a++ ; b+++ (diffuse also cricoïd cartilage)
27	♀	80	Several fractures of the thyroïd cartilage and also of a few tracheal cartilages	a++ ; b+++ (diffuse, also cricoïd and first tracheal cartilages)

a– unossified joints of the tongue-bone elements
a+ unilateral ossified joints of the tongue-bone elements
a++ bilateral ossified joints of the tongue-bone elements

b– no or minimal ossification of laryngeal cartilages
b+; b++; b+++: little; moderate; strong ossification

So, in a series of 30 cases, less than half of the victims had throat-skeleton fractures. By means of a series of personal observations, Zeldenrust showed as well that such fractures are not constantly occurring injuries.

From our data it clearly shows that a connection exists between the frequency of these injuries and the age of the victims. The radiological examination from which the data was summarized in the following table, shows that this connection is based on the degree of ossification of the throat-skeleton.
We ascertained that younger victims who did not receive fractures, showed unossified or little ossified laryngeal structures. Mostly were the joints of the tongue-bone elements unossified. Older victims with fractures, on the contrary, always showed a lesser or stronger degree of ossification of the laryngeal cartilages.

Discussion

Many authors as Prokop, Polson, Zeldenrust, Schrader, Hofmann and Haberda have also proved that the connection between the occurrence of throat-skeleton fractures and age, is based upon the degree of elasticity of the laryngeal structures. This elasticity decreases with age. The ossification of the cartilages of the larynx must therefore be considered as a process of ageing. According to Polson. throat-skeleton fractures rarely occur since most of the victims of strangulation have not yet attained the fourth decade. According to this author, the larynx is still cartilaginal at that age and the tongue-bone elements are still flexible in relation to each-other. Hofmann and Haberda also do emphasize that the laryngeal cartilages ossify between 40 and 50 years of age, although these authors do concede that ossification often occurs earlier. According to these authors the female larynx structures often remain uncalcified and unossified until old age. It may also happen on occasion with the male. According to Zeldenrust the throat-skeleton fractures would increase after the 30-th year. This could explain the higher frequency of fractures in his series. In the 22 cases of fractures, 3 victims were younger than thirty and 19 victims were 30 years and older. Of his 20 cases with an intact laryngeal skeleton, 13 victims were younger, and 7 were older than thirty years.

Our radiological data however shows that ossification of the articulations of the hyoid bone and of the laryngeal cartilages are not necessarily correlating with a certain decade of life. This ossification even can start at early age. Zeldenrust also does admit divergent variations on this item. An extensive radiological study of the larynxskeleton of both sexes has been carried out by Patenko, and this in function of the different periods of life. He also showed that the ossification of the larynx does not follow a fixed pattern. In general the ossification of the laryngealskeleton of the female does develop slower and in a lesser degree. This is also the case concerning the articulations of the tonguebone and of the thyroidcartilage. By the way, it is known that the larynx of eunuchs and of hermaphrodites remains undeveloped and soft. Peters and Umlandt have an extensive series of cases (n= 265), all with X-ray of the hyoid bone and larynx skeleton. This material came from persons, age 3 to 97. The conclusions of their study can be summarized as follows: – in cases of hanging and strangulation, as well as in those of other unnatural manners of death, fractures were observed more often than usually described. Hence the importance of the systematical X-ray examination;

– the obvious connection between the degree of ossification and the frequency of fractures;

– the ossification doesn't as a rule increase progressively.

Relatively often the authors found ossified structures in young persons as well as unossified structures in persons of advanced age. Also they didn't found statistical differences in the grade of ossification between men and women of the same age-group.

It is, according to these authors, obvious that an estimation of the age or the determination of the sex with help of X-ray examination of the throat-skeleton, must be regarded with great reservation. They found also fractures of the hyoid bone and larynx-skeleton in cases of natural death, especially after an infarct or an acute failure of the heart. These fractures are evidently the result of intense contractions of muscles. Most of those cases were more than 50 years old and showed a strong or completed ossification of the larynx structures.

The examination of our series of strangulation cases shows clearly that fractures of the throat-skeleton does not occur regularly. Their appearance, however, does not occur indifferently. Indeed, as the degree of ossification in the laryngeal structures increases with age, the risk of getting a fracture by strangulation is greater. It needs no argument that the intensity and the location of the exerted pressure on the larynx are equally important factors concerning the origin of these injuries. In a series of about hundred cases of self-strangulation, studied by Weimann and Spengler, only a few fractures were found. The exerted pressure on the larynx in suicide by strangulation is in general weak. Because in cases of strangulation by ligature, the level of constriction is generally below the hyoid bone, injuries to this bone are rather uncommon. But fractures of this bone will of course also depend on the breadth of the ligature. A broad ligature may compress and fracture the hyoid bone.

Notwithstanding the irregular occurrence of throat-skeleton fractures, these injuries obviously have a great diagnostic value, as a matter of course, if they are accompanied by haemorrhage (vital reaction).

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