

# BONWILL'S TRIANGLE IN RECENT ADULTS

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The American dentist and inventive genius, William Gibson Arlington Bonwill (1833—1899) of Philadelphia, founder of the modern science of dental articulation, (Dunning, Davenport 1947) measured also macerated skulls and anthropological distances of many lower jaws. His findings resulted in Bonwill's triangle, bounded by the lines running from the centre of the alveolar ridge to the centre of the head of the condyloid process on either side and from the centre of one mandibular head to the other. The sides of this equilateral triangle are 10 cm long. Instead of the centre of the inferior alveolar ridge (arcus alveolaris) or infradentale, one can locate the angular point of the triangle also in the contact point of the median lower incisors in the median sagittal plane (incisale inferius). (Kantorovicz 1932, Hammer, Reichenbach, Wannenmacher 1941.)

Bonwill's triangle was used and is still used in prosthetic dentistry for constructing patterns of artificial teeth. (Häupl, 1956.) Its significance for anthropology and anatomy lies in the determination of some characteristics of the lower jaw and mainly of the length of the distance between both mandibular bodies and rami from the median sagittal plane and of the curve of the lower jaw. The shape and the dimensions including the breadth of the mandible vary according to both the individual and the race. In dolichocephals with long and relative little distant mandibular bodies its summit lies behind the incisors, as in most European peoples. On the other hand, in some brachycephals, in the yellow races and in the Eskimos with a short mandibular body and a very expressive horseshoe convexity of the jaw, the apex of Bonwill's triangle projects before the incisors (cf. Fig.). (Paturet 1951, Martin — Saller 1957). According to Molnár and Huszár (cited by Andrik 1965), one side of the triangle measured 12 to 12.5 cm in neolithics.

But the laws of Bonwill's triangle in the building of the lower jaw are, as seen lately, only approximate ones. In order to ascertain their validity in our circumstances, we have stu-

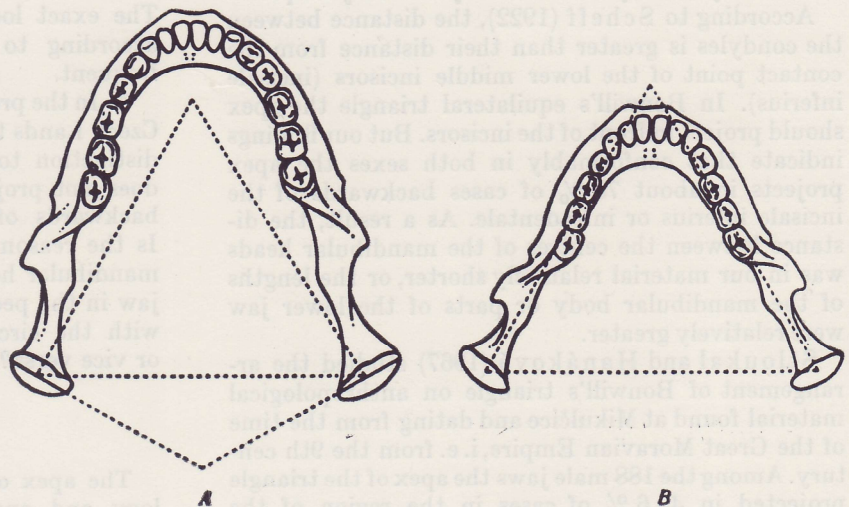
died the arrangement of Bonwill's triangle on 59 macerated mandibles of adult men and women, living in this country in the 20th century.

## PERSONAL OBSERVATIONS

Bonwill's triangle was measured on the macerated mandibles of 36 men between 23—73 years and in 23 women 19—83 years of age. The base of the equilateral triangle connected the centres of both mandibular heads. The location of its apex was studied in respect to the contact point of the lower incisors. In case it was impossible to determine this middle inferior incisal point, i. e. if the incisors were missing, the measurements were made from the infradentale. The obtained data relate only to the distances in the sagittal direction. The lateral deviations of the apex of the triangle were frequent. They are the result of asymmetry of the lower jaw.

The number of cases in the individual decades was as follows:

Men: In the 3rd decade 13 cases, in the 4th decade 12 cases, in the 5th decade 5 cases, in the 6th decade 4 cases, in the 8th decade 2 cases.



Bonwill's triangle in dolichocephals (A) and in brachycephals (B). (From Paturet).



Women: In the 3rd decade 9 cases, in the 4th decade 5 cases, in the 5th decade 1 case, in the 7th decade 6 cases, in the 9th decade 2 cases.

## RESULTS

### Men

1. The apex of Bonwill's triangle coincided with the contact point of the lower middle incisors (*incisale inferius*) and/or with the infradentale only in 11.1 % (4 cases).

2. In front of these points, the apex of the triangle projected in 16.7 % (6 cases). The mean distance was 6.7 mm (extreme values were 2—10 mm).

3. Backwards of the points mentioned above, the apex of Bonwill's triangle projected in 72.2 % (26 cases). The mean distance was 8.6 mm (extreme values were 2—18 mm).

### Women

1. The apex of Bonwill's triangle coincided with the contact point of the lower incisors and/or with the infradentale only in 8.7 % (2 cases).

2. In front of these points, the apex of the triangle projected in 17.4 % (4 cases). The mean distance was 7.3 mm (extreme values were 2—18 mm).

3. Backwards of the points mentioned above, the apex of Bonwill's triangle projected in 73.9 % (17 cases). The mean distance was 7.8 mm (extreme values were 3—14 mm).

## DISCUSSION

The values of the base of Bonwill's equilateral triangle (10 cm — Bonwill) and thus of its sides vary to a great extent. Also the distance of the centre of *caput mandibulae* from the contact point of the middle incisors and/or from infradentale generally differ frequently on both sides. These older findings agree with the great variability of the mandible (H. Virchow) and with our own measurements according to sex and age (Dvořák). It has been found that the individual differences are remarkable and the asymmetry of the lower jaw is very frequent.

According to Scheff (1922), the distance between the condyles is greater than their distance from the contact point of the lower middle incisors (*incisale inferius*). In Bonwill's equilateral triangle the apex should project in front of the incisors. But our findings indicate that conformably in both sexes the apex projects in about 73 % of cases backwards of the *incisale inferius* or infradentale. As a result, the distance between the centres of the mandibular heads was in our material relatively shorter, or the lengths of the mandibular body or parts of the lower jaw were relatively greater.

Stloukal and Hanáková (1967) studied the arrangement of Bonwill's triangle on anthropological material found at Mikulčice and dating from the time of the Great Moravian Empire, i. e. from the 9th century. Among the 188 male jaws the apex of the triangle projected in 43.6 % of cases in the region of the incisors, in 14.4 % of cases in front of the dental

arch, in 42 % of cases backwards of it. Among 129 female mandibles the apex of the triangle projected in 37.2 % of cases on the incisors, in 22.5 % of cases in front of them, in 40.3 % of cases backwards from them. In many cases the apex of Bonwill's triangle deviated from the median sagittal plane to the right or to the left. The right-sided deviations were twice as frequent as the left-sided ones.

These findings of Stloukal and Hanáková, supposing the prevalence of length of the right hemimandible, agree with the results of our studies on the asymmetry of recent mandibles: the circumference, the diagonal and the length of the body of the lower jaw were found to be greater on the right side. From the comparison of the rich discoveries from the period of the Great Moravian Empire with our recent jaws it is clear that in the people of the Czech Lands in the 9th century as well as in the 20th century the apex of Bonwill's triangle projects more often backwards from the lower incisors, in our days in nearly three quarters of cases in men and women.

## CONCLUSIONS

1. Bonwill's triangle is still of importance in anthropology and anatomy after one hundred years.

2. The arrangement of Bonwill's triangle was studied in 36 recent male and 23 female macerated mandibles. The exact projection of the apex of the triangle on the contact point of the lower middle incisors (*incisale inferius*) and/or on the infradentale is least frequent (in 11.1 % of cases in men, in 8.7 % of cases in women). The apex of this equilateral triangle was most frequently located backwards from the points mentioned above (in 72.2 % of cases in men, in 73.9 % of cases in women), less frequently in front of them (in 16.7 % of cases in men, in 17.4 % of cases in women).

3. The comparison with the findings from the period of the Great Moravian Empire (9th century) showed that the apex of Bonwill's triangle projects conformably more often backwards of the *incisale inferius* or infradentale, less often in front of them. These differences are more striking in recent jaws. The exact localisation of the apex of the triangle according to Bonwill's conception is then least frequent.

4. In the prehistoric and recent mandibles from the Czech Lands the apex of Bonwill's triangle, in contradistinction to the older views of German authors, does not project in front of the lower incisors, but backwards of them. The question remains open: Is the reason of it the lesser distance between the mandibular heads or the greater length of the lower jaw in the people of the Czech Lands in comparison with the circumstances in other nations or races, or vice versa?

## SUMMARY

The apex of Bonwill's triangle used in anthropology and anatomy projects in the mandibles of recent men and women in about 73 % of cases some



8 mm backwards of incisale inferius and/or from infradentale, much more infrequently in front of these points (in about 17 % of cases), more scarcely directly in these points (in about 10 % of cases). This posterior shifting of the apex of Bonwill's triangle seems to be the result of development, as seen from the comparison with mandibles from the period of the Great Moravian Empire (9th century). The obtained findings are opposed to the older views, according to which the apex of the triangle projects in front of the lower incisors. Taking into consideration the great variability of the lower jaw, possible differences in nations or races cannot be omitted.

#### SOUHRN

Bonwillův trojúhelník užívaný v antropologii a v anatomii se promítá u mandibul recentních mužů a žen svým vrcholem asi v 73 % případů přibližně 8 mm vzad od dolního incisálního bodu (incisale inferius) resp. od infradentale, mnohem méně často před něj (asi v 17 %), ještě vzácněji přímo do něho (asi v 10 %). Tento dorsální posun vrcholu trojúhelníku se zdá být podmíněn vývojově, jak vyplývá ze srovnání s čelistmi z doby Velkomoravské říše (9. století). Získané výsledky jsou protichůdné starším údajům, podle nichž se vrchol trojúhelníku

promítá vpřed od řezáků. S přihlédnutím k velké variabilitě mandibuly nelze pominout případné rozdíly národnostní či plemenné.

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