4 Patients and methods

The patients in this study were children and young asults from Tampere and the surrounding communes who were treated for clubfoot deformity in the CHT in the years 1963—78. The shortest follow-up time was 3 years 4 months, the longest 29 years 7 months. The age distribution at follow-up and number of feet is presented in Figure 1.

Treatment of the oldest patients was started elsewhere and they were remitted to the CHT when the Department of Paediatric Surgery was opened in 1963.

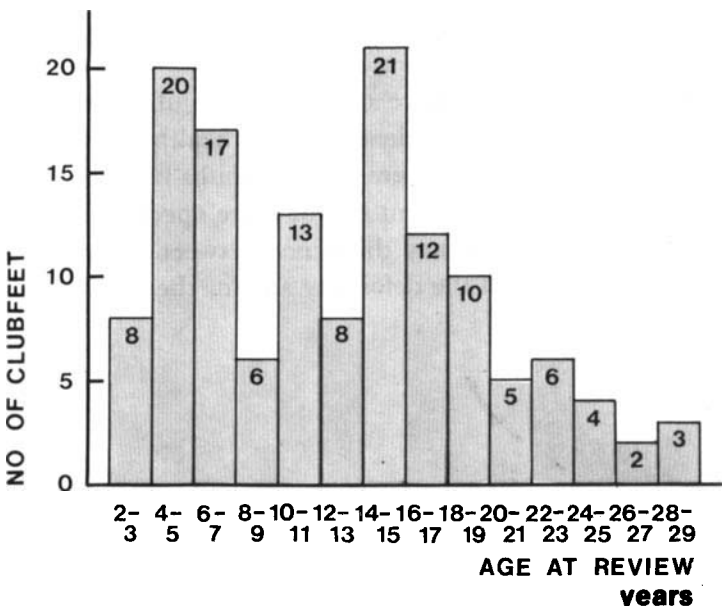

Figure 1. Distribution of clubfeet in different age groups at follow-up.

Clubfeet of secondary origin (meningomyelocele, arthrogryposis etc.) as well as acquired (CP, polio etc.) and of persons who had died were excluded. People who were invited for a clinical and radiological follow-up examination and interview were thus those with an idiopathic, true or postural clubfoot deformity.

4.1 Composition of patient series

Table 10. Clubfoot patients in the CHT and set-up of the follow-up series.

All clubfeet	**127**	**patients**
Secondary or acquired	**17**	"
Dead	**3**	"
Invited cases	**107**	"
Emigrated	**3**	"
Archives: Not available	**1**	"
No reaction to repeated invitation	**7**	"
Follow-up	**96**	"

Of the follow-up patients 22 were girls. Bilateral cases were 39 (12 of the girls, i.e. 55 per cent, and 27 of the boys, i.e. 36 per cent were bilateral). Thus the number of clubfeet was 135.

Of the feet 56 per cent were operated once, 18 per cent were reoperated and 26 per cent were treated conservatively by manipulation, strapping, splinting, and plaster casts.

The main type of primary operation was posteromedial release (In bloodless field, an incision is started behind the medial melleolus and extended downwards over the region of the navicular. The tibialis posterior-tendon is severed at its navicurar attachment, the talonavicular joint widely opened, the deltoid ligaments excised thoroughly and the achilles tendon severed through the same incision. When necessary, a posterior ankle and subtalar capsulectomy is carried out.). Of the 100 operations performed, 76 were of this type.

In 19 cases the primary operation was an achilles tenotomy, in two cases an osteotomy, once a myotomy, once a posterior release and once a medial release (24/100 operations).

4.1.1 Comments

The clubfoot material in the CHT has accumulated in a natural way, and consists of all cases of TEV in the area. No selection took place as none of either the more severe or the easier cases has been excluded. The methods of operative and conservative therapy, especially the latter, have been fairly uniform and have been carried out by three pediatric surgeons (by Dr V. Paltia until 1972 and by Dr K. Järvilehto and the author ever since). Individual difference in the methods that would not appear in the statistics is not involved. Cases operated

at younger age, however, accumulated in the younger age groups at follow-up as shown in Table 17 A, page 49.

Generally, the 74 per cent operation rate in this study was relatively high, as the corresponding figure from the total of 3647 feet in the literature which was reviewed for this study was 48 per cent. The individual figures are given in Table 9, page 29.

4.2 Methods

4.2.1 Classification of feet

According to the severity of their primary appearance, the clubfeet were classified into three grades:
Grade 4. Severe clubfoot (extreme malposition which, because of its rigidity, cannot be brought even close to the normal position).
Grade 3. Moderate clubfoot (distinct malposition, less rigid than the former and can be moulded at least partially close to normal).
Grade 2. Mild or postural clubfoot (the malposition is less marked, the rigidity, especially that of the equinus, gives way easily and the foot can be brought into the normal position without force).
Grade 1. Comprises normal feet.

4.2.2 Control group

On account of bilateral cases and as the number of unilateral cases was small and there was some suspicion concerning the quality of the "healthy legs" in the latter, a control group of persons with healthy feet was collected. Individuals included in the control group were hospitalized in the year 1982 for trivial reasons (hernia, phimosis, minor head injury, eye injury, fracture of the upper extremity etc.). Their ages corresponded to the ages of the clubfoot patients. The 892 control persons were examined clinically.

For ethical reasons it was impossible to gather radiological information from the controls. This was reflected in the construction of scores, as the expected values for healthy persons are based on data, obtained from the few healthy feet of patients. Thus we cannot speak about "deviations from the normal", and the results must be considered within different groups of clubfeet instead. (Construction of scores, page 40)

4.2.3 Follow-up examination

In order to get a real and thorough picture of the present condition of persons treated for clubfoot, the 96 patients were examined by the author clinically and radiologically, as well as interviewed as to their personal opinion on their fitness. Anamnestic data on details of pregnancy, the patients' status, and the treatment were also gathered. In the appendix to this study the form used for this purpose, its explanation and instructions for the X-ray examinations are included (pages 104—109, Tables 42—45). In the planimetries a HAFF Planimeter No 317 E was used.

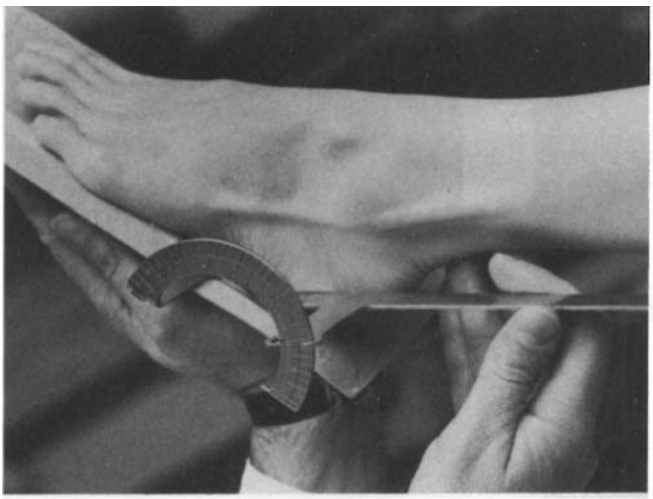

Figure 2.
Measuring the plantar and dorsiflexion of the ankle.

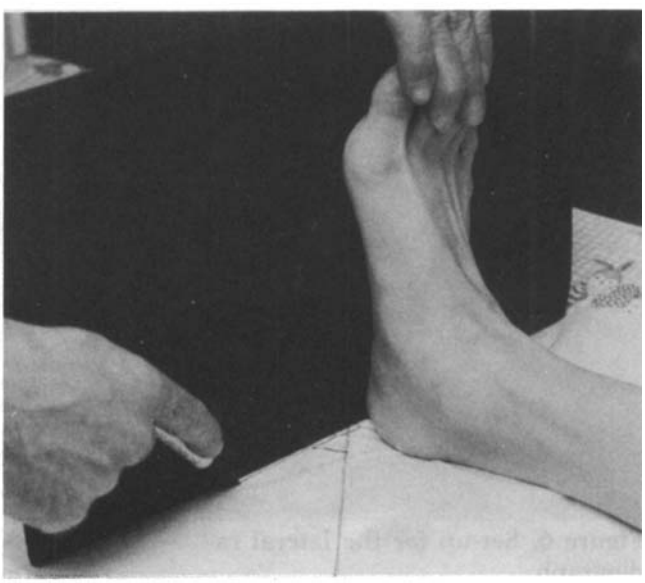

Figure 3.
Measuring the sidewards flexibility of the ankle.

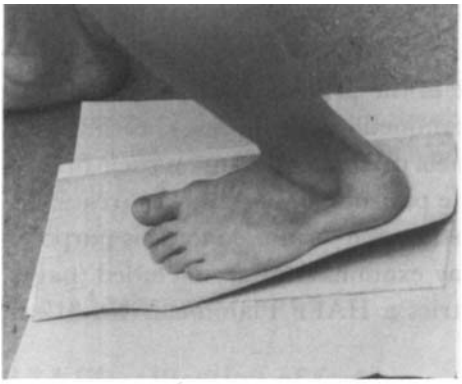

Figure 4. Taking the footprint for evaluation of the vault of the foot.

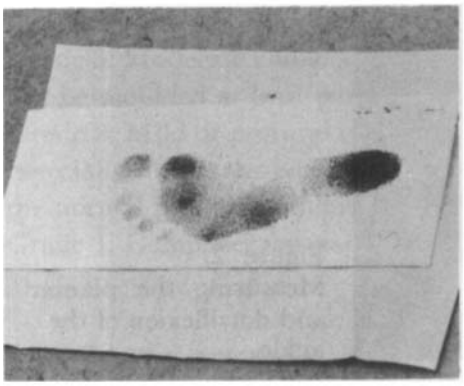

Figure 5. The footprint.

Figure 6. Set-up for the lateral radiograph.

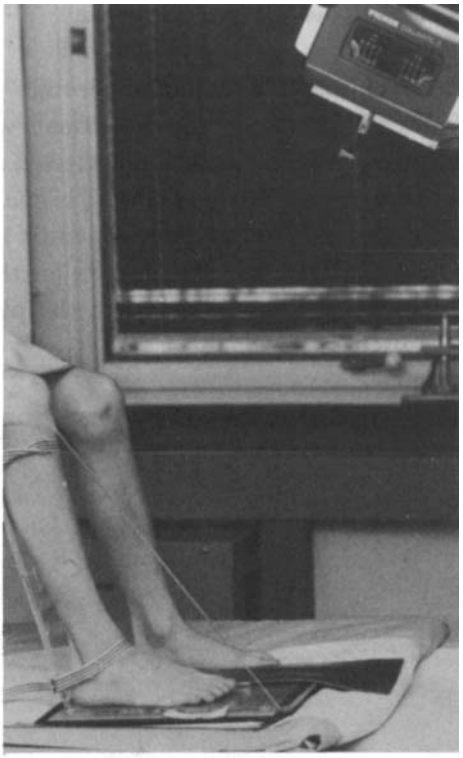

Figure 7. Set-up for the dorsiplantar radiograph.

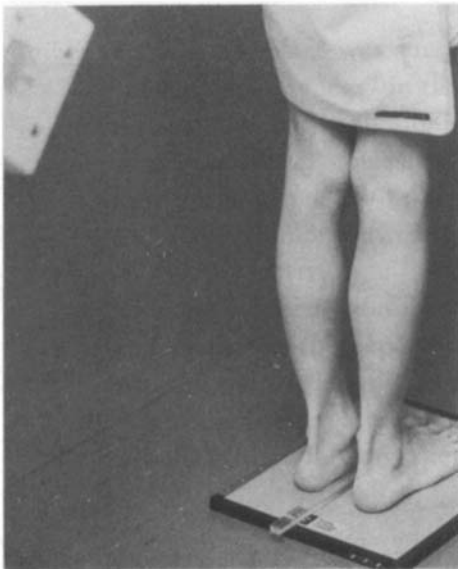

Figure 8. Set-up for the suroplantar radiograph.

Figure 9. Set-up for the ankle joint a-p radiograph.

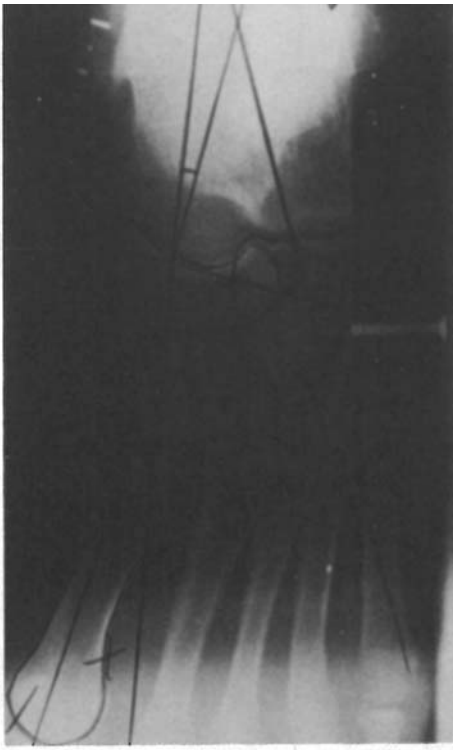

Figure 10. A dorsiplantar radiograph.

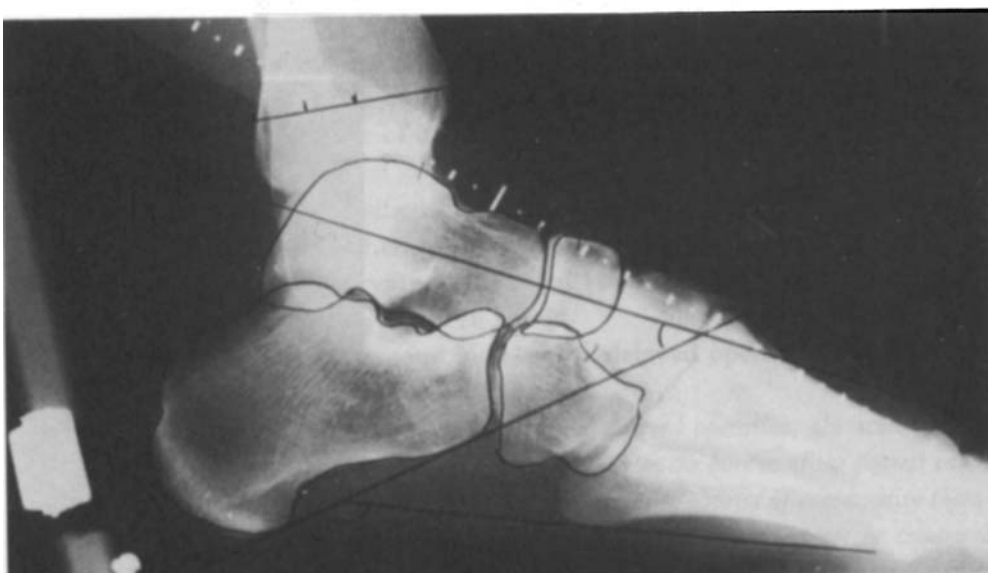

Figure 11. A lateral radiograph.

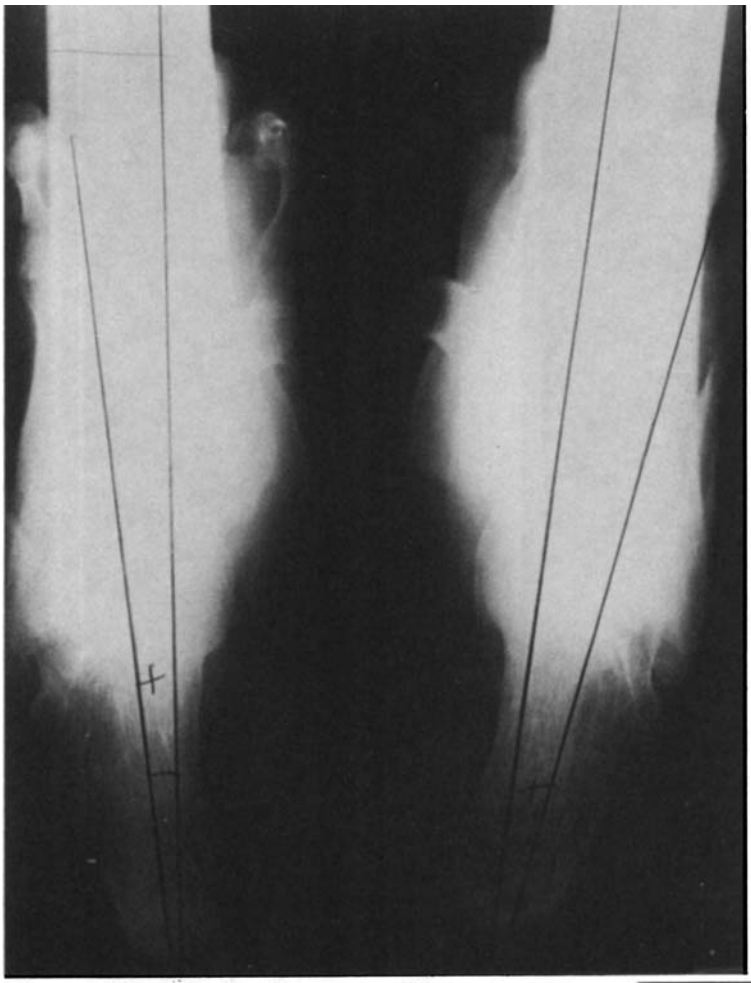

Figure 12. A suroplantar radiograph.

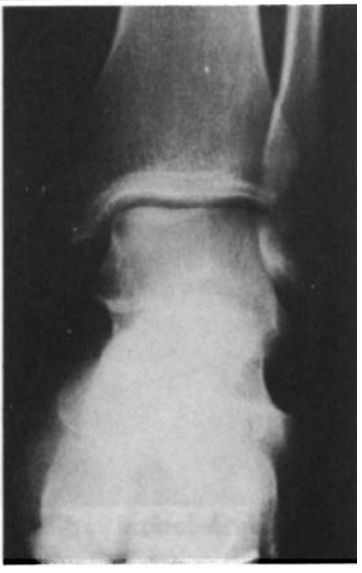

Figure 13. An ankle a-p radiograph.

4.2.4 Data processing

The variables measured at follow-up were divided into four groups representing

1. The size of foot and leg (the metric and planimetric variables).
2. The functional result (dorsiflexion and plantarflexion of the ankle, the sidewards flexibility of the ankle, squatting, standing on the toes, the talar class, the tibial epiphysis, daily life, pain, fatigue, and the shoes).
3. The shape of the foot (radiological angles, retroposition of the fibula and the vault of the foot), and
4. Psychosocial aspects.

These groups were considered separately in assessing the final results and their possible correlations to other factors. In assessing the correlation of type of therapy and results of it, grade 2, i.e. the postural clubfeet and, finally, to exclude completely the effect of the primary grade of TEV, even grade 4 feet were exluded.

Where appropriate, the dependence of the measured variables on the age at follow-up in boys, in girls, in the clubfeet, in the patients' healthy feet, and in the controls was presented with median curves smoothed by hand. (Figures 14 to 53, pages 52—71). The small number of healthy feet in girls must be taken into regard when surveying the curves.

The dependence of all parameters on the age at follow-up, on the primary grade of TEV, and on the sex of the patients was also tested. In the primary grade of the TEV the alternative hypothesis H_a is directed, in others it is undirected.

As far as the dependence of results on the timing of the operation is concerned, the children were divided into four groups:

1. Operation within the first week of life,
2. Operation at the age of one week to one year,
3. Operation at the age of one year or later, and
4. No operation.

The type of therapy was classified into:

1. Primary operative therapy, i.e. operation in the neonatal period without previous conservative treatment (45 feet),
2. Conservative therapy (35 feet), and
3. Conservative therapy combined with a delayed operation when indicated (55 feet).

As failing conservative therapy has resulted in a delayed operation, the scores in the conservatively treated feet were outcome of selection, free from the burden of the poorest cases. Although the classification performed offered the only access to aspects of conservative therapy and was therefore adopted, the results of three types of therapy could not be compared without reserve. The results achieved with a primary operative type of therapy were therefore also compared with the combined results of the other two types of therapy.

To assess the final results and to find out the influence on them of different types of therapy, the readings gathered at follow-up were standardized in respect of age, sex, and the individual size (if an interdependence existed concerning the measured variable).

As far as the metric quantities were concerned a ratio obtained by dividing the patient's reading by the moving average (the average reading of the year of birth and the two adjacent years) of the same quantity in controls of equal age and sex was to be regarded independent of the age and sex. Dividing this ratio by the ratio of the length of the leg of the same patient and the moving average of the length of the leg in controls of equal age and sex eliminated the influence of individual size (length of leg was regarded as an indicator for individual size). This final ratio thus represented solely the interdependence between primary grade, therapy, and result of treatment.

The same can be presented as a formula in which Rp70 means the reading of a patient born in 1970, Rc69—71 the moving average of the reading of the same quantity in controls of equal age and sex, Rpl70 the length of the leg of the same patient, Rcl69—71 the moving average of the length of the leg in controls of equal age and sex and Raf the final ratio: Rp70:Rc69—71 = Ral; Ral: (Rpl70/Rcl69—71) = Raf !

4.2.5. Construction of scores

The three scores used as output measures were constructed in such a way that 5 to 10 primary observations were summed evenly weighted. The primary observations were first transformed so that 100 represents the expected value for a healthy person and lower value signifies some kind of loss or malformation. Transform functions were found by regression analysis. The score as an arithmetic mean shows then the same property (100 expected for a healthy person). The matter has been touched upon on page 34. The formulae used are as follows:

X as shape measures of X-rays

$x(1) = 0.6 \times$ talocalcaneal index

$x(2) = 100 - 1.5 \times$ talus/metarsus I (MI) angle, l-p projection

$x(3) = 100 -$ absolute value of (calcaneum/metatarsus V (MV) angle — 145)

$x(4) = 70 -$ talonavicular angle a-p

$x(5) = 80 -$ calc. varus/valgus

$X =$ mean of $x(i)$

F as fuction measure

$f(1) = 150 -$ dorsiflexion of the ankle

$f(2) =$ plantarflexion of the ankle $- 50$

$f(3) = 40 + 20 \times$ squatting score

f(4) = 2 × sidewards flexibility of the ankle
f(5) = 25 × talar class
f(6) = 40 + 20 × tibial epiphysis
f(7) = 20 × score of daily life
f(8) = 20 × score of pain
f(9) = 10 + 30 × score of shoes
f(10) = 10 + 30 × score of fatigue
F = mean of f(i)

S as measure of size

s(1) = standardized length of the foot
s(2) = standardized breadth of the foot
s(3) = standardized circumference of the thigh
s(4) = standardized circumference of the calf
s(5) = standardized cuboides index as follows
Norm for boys: 30 + 10 × age in years, if greater than 180 then 180
Norm in girls: 30 + 7 × age in years, if greater than 125 then 125
s(5) = 100 + cuboides index — Norm
s(6) = standardized navicular index,
Norm for boys: $0.4 \times age^2 + 3.2 \times age - 13.2$, if greater than 115 then 115 if less than 1 then 1
Norm for girls: 6.4 × age — 10, if greater than 80 then 80, if less than 1 then 1
s(6) = 100 + navicular index — Norm
s(7) = standardized calcaneal index,
Norm for boys: $0.625 \times age^2 + 6.25 \times age + 66$, if greater than 330 then 330
Norm for girls: $0.625 \times age^2 + 6.25 \times age + 66$, if greater than 210 then 210

s(8) = standardized talar index,
Norm for boys: 20 + 10 × age, if greater than 180 then 180
Norm for girls: 20 + 8 × age, if greater than 140 then 140
s(8) = 100 + talar index — Norm
S = mean of s(i)

4.2.6 Statistical tests

The object of this study led to direct hypothesis setting (one-tailed interpretation) in questions 2 and 3 on page 31. The other questions 1, 4 and 5 were by nature nondirected and two-tailed interpretation was used.

Discrete distributions were always tested with Chi-square using the Yates

correction or its extension if appropriate. In the 2x2 contingency table both two tailed and one-tailed interpretations are possible, whereas in a general NxM table only an undirected difference from random distribution may be tested.

Continuous variables were tested in the standard way, so that in cases of only two samples the means were compared by Student's t-test and in cases of three sample means the one way analysis of variance was applied. In the latter H_0 signifies that there is no difference in population means. H_1 indicates a difference but no direction.

In this study continuous variables were also tested in the first screening by NxM contingency table, treating them as nominal variables with three or four classes. A low-power test was deliberately used to minimize false findings of statistical difference. All tests were carried out on a digital computer (PDP-11/34 or Osborne 1).

Table 11. Statistics of statistics

Chi-square 2x2 in Tables 12,13 and 16
Chi-square NxM to ordinal in Table 28, interval in Tables 15,17—19,21—23 and 25—27
t-test in Table 16,20,24 and Tables 33—37
One way analysis of variance in Tables 29,30,31,32 and 40
None in Tables 10,14 and 41