Progression of waist-hip circumference ratio in full-term symmetric and asymmetric small for gestational age infants

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ABSTRACT

Background: Children born as small for gestational age (SGA) tend to develop central adiposity and may have chances of developing metabolic syndrome. Waist–hip circumference ratio (WHR) is considered as a good indicator of central/truncal obesity. The complete absence of information on growth dynamics of WHR among Indian symmetric and asymmetric SGA infants has prompted us to undertake this study.

Aim: The aim was to study the pattern of growth of waist circumference, hip circumference, and WHR of symmetric and asymmetric SGA infants.

Materials and Methods: Waist and hip circumference of full-term 100 symmetric SGA, 100 asymmetric SGA, and 100 appropriate for gestational age (AGA) infants was measured at 1, 3, 6, 9, and 12 months in Growth Laboratory/Clinic of the Department. Student’s unpaired t-test was used to assess intragroup (symmetric vs. asymmetric), intergroup (SGA vs. AGA), and gender differences.

Results: A consistent increase in the mean waist and hip circumference was noticed among symmetric and asymmetric SGA and AGA infants of two sexes. Male infants of both SGA groups possessed similar waist and hip circumference at 1 month. Whereafter, asymmetric SGA males had a larger waist and lesser hip circumference than symmetric infants. Asymmetric SGA females possessed larger waist circumference throughout infancy, while hip circumference measured larger only till 3 months as compared to symmetric females.

Conclusion: SGA infants of two types and gender exhibited compromised auxological attainments for waist and hip circumference compared to normal babies. Higher WHR recorded in asymmetric SGA than symmetric SGA and AGA babies appear to suggest that asymmetric infants may have greater tendency to develop central obesity, subsequently.

Keywords: Hip circumference, infant growth, small for gestational age, waist circumference, waist–hip ratio

Introduction

The waist–hip circumference ratio (WHR) known to distinguish between the amount of fat in the lower (hip and buttocks) and upper trunk (waist and abdomen areas) is an important measure of central or truncal obesity. Accumulation of adipose tissue, particularly in the abdominal region, is fundamental to triggering off the metabolic syndrome. Epidemiological evidence reveals that there exists a relationship between small for gestational age (SGA) infants and developing metabolic syndrome in later life. SGA is known to be associated with increased incidence of hypertension, cardiovascular, and noninsulin-dependent diabetes mellitus (Type II) including central obesity in later childhood and adulthood. Adverse distribution of body fat may carry a risk for morbidity as great as or greater than total amount of body fat. The WHO Expert Consultation on Obesity has suggested WHR as

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a measure of distribution of subcutaneous body fat to identify individuals having more risk of obesity-related morbidity because of excessive deposition of fat in abdominal region. The WHR can be measured easily and precisely, as it provides an index of both subcutaneous and intra-abdominal adipose tissue.\textsuperscript{10} Waist circumference and WHR have also been suggested to edge over body mass index in predicting cardiovascular disease risk.\textsuperscript{11}

The WHR has been used extensively in adults to assess obesity-related issues, while information related to infants and children is scarce. In view of the complete absence of longitudinal information on the circumference of waist and hip as well as WHR of SGA babies, we have attempted to study auxological dynamics of these circumferential measures of growth among symmetric and asymmetric SGA infants of Indian origin and compare with those born as appropriate for gestational age (AGA).

Materials and Methods

Two hundred full-term SGA (i.e., symmetric SGA: male 50 and female 50; asymmetric SGA: male 50 and female 50) and 100 (male 50 and female 50) AGA babies born to parents belonging to upper middle to upper high socioeconomic strata,\textsuperscript{12} in the labor room of the institute envisaged sample for this serial study. Babies weighing within 10\textsuperscript{th}–90\textsuperscript{th} percentile of intrauterine growth curves\textsuperscript{13} at birth were considered as AGA, while babies having birth weight <10\textsuperscript{th} percentile were defined as SGA. Ponderal Index (PI) was used to classify full-term SGA babies into asymmetric SGA (PI <2.2 g/cm\textsuperscript{3}) and symmetric SGA (PI ≥2.2 g/cm\textsuperscript{3}).\textsuperscript{14,15} Other relevant details concerning health, dietary intake, statistical and sampling methods employed, and follow-up procedure followed are given elsewhere.\textsuperscript{16,17}

After providing relevant information regarding study objectives and methodology, etc., to be followed, parental consent of babies included in the study was taken. An approval of “Institutional Ethics Committee” was also obtained. Each participant was measured for waist and hip circumference employing standardized anthropometric techniques,\textsuperscript{18} with the help of fiberglass tape (least count: 1 mm) at 1 month (±3 days), 3, 6, 9, and at 12 months of age (±15 days) following a mixed-longitudinal method in Growth Laboratory and Growth Clinic of the Institute. Waist circumference was measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest. Hip circumference was measured at the point of maximum protuberance. WHR was obtained by dividing waist circumference by hip circumference. The participants who missed follow-up were measured in their homes.

Statistical analysis

Mean and standard deviation (SD) for circumference of waist and hip as well as WHR were computed from anthropometric data gathered on two types and gender of SGA as well as AGA babies by applying statistical method given by Tanner.\textsuperscript{19} Unpaired Student’s t-test was used to compute intragroup (symmetric SGA vs. asymmetric SGA), intergroup (SGA vs. AGA), and gender differences.

Results

Age- and gender-wise distribution of both symmetric and asymmetric SGA as well as AGA babies examined at different age levels during infancy are shown in Table 1, while mean (SD) of waist circumference, hip circumference, and WHR are presented in Table 2 and Figures 1-5. In general, a consistent increase in the mean distance attainments of waist and hip circumference was observed among all SGA and AGA babies [Table 2]. As compared to AGA male and female infants, both waist and hip circumferences remained significantly ($P \leq 0.001$) lesser in symmetric and asymmetric SGA babies throughout infancy [Tables 2 and 3].

Mean waist circumference among asymmetric SGA, in general, was larger than those of the symmetric infants. However, it exhibited same attainments at 1 (i.e., 33.8 cm) and 12 (symmetric: 41.4 cm and asymmetric: 41.5 cm) months in male SGA infants. Interestingly, the difference between symmetric and asymmetric SGA babies became significant ($P \leq 0.01$) only at 3 months [Table 2 and 3]. Male symmetric and asymmetric SGA as well as AGA infants had larger values for waist circumference than their respective female counterparts, and the magnitude of gender differences became statistically significant at most of the age levels.

| Age (±months) | Symmetric SGA | Asymmetric SGA | AGA |
|---------------|---------------|----------------|-----|
|               | Male | Female | Male | Male | Female | Male |
| 1              | 50   | 50     | 50   | 50   | 50     | 50   |
| 3              | 46   | 47     | 46   | 46   | 47     | 47   |
| 6              | 44   | 48     | 46   | 42   | 47     | 47   |
| 9              | 48   | 48     | 50   | 47   | 48     | 46   |
| 12             | 45   | 49     | 46   | 45   | 49     | 48   |

SGA - Small for gestational age, AGA - Appropriate for gestational age
Hip circumference, in general, measured more in symmetric SGA infants than asymmetric ones. However, exception was male SGA infants of the two types who possessed same value 1 month (i.e., 31.0 cm) and female asymmetric SGA babies who had larger hip circumference till 3 months. Intragroup differences for this circumferential measurement remained statistically nonsignificant [Tables 2 and 3]. Mean hip circumference measured larger in symmetric SGA male infants up to 3 months whereafter; female symmetric SGA babies did so. Gender differences became statistically significant ($P \leq 0.01$) at 12 months, only. Gender differences for hip circumference of asymmetric SGA babies were statistically nonsignificant [Table 3]. The male AGA infants possessed larger hip circumference than the female infants, and gender differences were recorded to be significant at 1 ($P \leq 0.01$) and 3 ($P \leq 0.05$) months.

WHR in symmetric (male: 1.09, female: 1.08) and asymmetric (male: 1.09, female: 1.10) SGA infants measured larger than AGA male (1.04) and female (1.04) infants at 1 month. Similar trend continued throughout infancy, and subsequently, the WHR at 12 months of age measured 0.99 and 0.95 among male and female AGA infants, respectively, which was lesser in magnitude than that recorded for symmetric (male: 1.01 and female: 0.97) and asymmetric (male: 1.01 and female: 1.0) SGA infants [Table 2]. WHR measured higher in male than female symmetric SGA, asymmetric SGA, and AGA infants. However, statistically significant gender differences between 3 and 9 months were recorded for symmetric SGA and AGA babies [Table 3].

**Discussion**

The pattern of body fat distribution is useful in determining disease risk. Individuals with a high proportion of abdominal fat and increased WHR are considered to be at
higher risks of developing metabolic alterations. Higher WHR attainments reflect both a relative abundance of fat in the abdominal region (i.e., increased waist circumference) as well as a relative decrease in gluteal tissues (i.e., decreased hip circumference). [21] This study is the first attempt to understand growth dynamics of waist and hip.

### Table 2: Mean (standard deviation) of waist circumference (cm), hip circumference (cm) and waist-hip ratio of male and female symmetric small for gestational age, asymmetric small for gestational age, and appropriate for gestational age infants

| Age (months) | Symmetric SGA | Asymmetric SGA | AGA |
|--------------|---------------|----------------|-----|
|              | Male          | Female         |     | Male          | Female         |     | Male          | Female         |     |
|              | Waist circumference | Hip circumference | Waist-hip ratio | Waist circumference | Hip circumference | Waist-hip ratio | Waist circumference | Hip circumference | Waist-hip ratio |
| 1            | 33.8 (1.51)   | 32.6 (1.76)    | 33.8 (1.95)   | 33.0 (1.84)   | 36.1 (1.60)   | 34.8 (1.66)   | 1.09 (0.08)    | 1.08 (0.06)    | 1.09 (0.07)    | 1.10 (0.09)    | 1.04 (0.04)    | 1.04 (0.07) |
| 3            | 37.2 (1.91)   | 36.2 (1.54)    | 38.3 (1.77)   | 37.3 (1.78)   | 39.5 (1.10)   | 37.5 (1.25)   | 1.02 (0.04)    | 1.00 (0.03)    | 1.04 (0.05)    | 1.02 (0.05)    | 1.00 (0.04)    | 0.98 (0.05) |
| 6            | 39.6 (1.69)   | 38.6 (1.46)    | 40.1 (2.15)   | 39.3 (1.98)   | 42.2 (2.56)   | 40.8 (2.07)   | 1.01 (0.03)    | 0.97 (0.03)    | 1.03 (0.06)    | 1.00 (0.07)    | 0.98 (0.04)    | 0.95 (0.05) |
| 9            | 40.9 (1.83)   | 39.9 (1.77)    | 41.3 (1.83)   | 40.5 (1.94)   | 43.5 (2.16)   | 42.1 (1.61)   | 1.00 (0.03)    | 0.97 (0.03)    | 1.02 (0.06)    | 1.00 (0.06)    | 0.98 (0.03)    | 0.95 (0.04) |
| 12           | 41.4 (1.69)   | 40.7 (1.80)    | 41.5 (1.76)   | 40.9 (1.88)   | 44.7 (2.37)   | 43.1 (1.36)   | 1.01 (0.04)    | 0.97 (0.03)    | 1.01 (0.05)    | 1.00 (0.06)    | 0.99 (0.03)    | 0.95 (0.03) |

### Table 3: Intergroup (small for gestational age vs. appropriate for gestational age) and intragroup (symmetric small for gestational age vs. asymmetric small for gestational age) and gender differences for waist circumference (cm), hip circumference, and waist-hip ratio of male and female symmetric small for gestational age, asymmetric small for gestational age, and appropriate for gestational age infants

| Age (months) | Gender differences | Symmetric SGA versus asymmetric SGA | Symmetric SGA versus AGA | Asymmetric SGA versus AGA |
|--------------|---------------------|-------------------------------------|--------------------------|--------------------------|
|              | Symmetric SGA       | Asymmetric SGA                      | AGA                      |                          |
|              | Waist circumference | Hip circumference                   | Waist-hip ratio          | Waist circumference      | Hip circumference | Waist-hip ratio |
| 1            | 3.784***             | 2.117*                             | 4.045***                 | 0.023                    | 1.191                   | 7.318***          | 6.362***          | 6.395***          | 4.992***          |
| 3            | 2.693**              | 2.634**                            | 5.549***                 | 0.271**                  | 2.987**                 | 5.452***          | 4.230***          | 2.999***          | 0.703             |
| 6            | 3.020**              | 2.178                              | 2.828**                  | 1.205                    | 1.883                   | 5.711***          | 6.135***          | 4.124***          | 3.835**            |
| 9            | 2.723**              | 2.112*                             | 3.708***                 | 1.007                    | 1.491                   | 6.273***          | 6.039***          | 5.426***          | 4.167**            |
| 12           | 1.852                | 1.628                              | 4.174***                 | 0.428                    | 0.437                   | 7.797***          | 7.298***          | 7.101***          | 6.361***            |

### Hip circumference

| Age (months) | Gender differences | Symmetric SGA versus asymmetric SGA | Symmetric SGA versus AGA | Asymmetric SGA versus AGA |
|--------------|---------------------|-------------------------------------|--------------------------|--------------------------|
|              | Symmetric SGA       | Asymmetric SGA                      | AGA                      |                          |
|              | Waist circumference | Hip circumference                   | Waist-hip ratio          | Waist circumference      | Hip circumference | Waist-hip ratio |
| 1            | 1.443                | 1.474                              | 2.800**                  | 0.041                    | 0.105                   | 6.998***          | 6.723***          | 8.375***          | 6.442***            |
| 3            | 0.588                | 0.361                              | 2.202*                   | 0.823                    | 1.242                   | 6.778***          | 5.728***          | 6.419***          | 5.149***            |
| 6            | 1.309                | 0.005                              | 0.268                    | 0.272                    | 1.462                   | 8.169***          | 6.970***          | 6.889***          | 7.732***            |
| 9            | 0.691                | 0.262                              | 0.325                    | 0.978                    | 1.290                   | 9.296***          | 8.236***          | 9.242***          | 8.289***            |
| 12           | 2.993**              | 0.233                              | 0.346                    | 0.525                    | 2.676*                  | 9.703***          | 8.399***          | 9.172***          | 9.850***            |

### Waist-hip ratio

| Age (months) | Gender differences | Symmetric SGA versus asymmetric SGA | Symmetric SGA versus AGA | Asymmetric SGA versus AGA |
|--------------|---------------------|-------------------------------------|--------------------------|--------------------------|
|              | Symmetric SGA       | Asymmetric SGA                      | AGA                      |                          |
|              | Waist circumference | Hip circumference                   | Waist-hip ratio          | Waist circumference      | Hip circumference | Waist-hip ratio |
| 1            | 0.707                | 0.607                              | 0.000                    | 1.000                    | 0.195                  | 0.000***          | 0.003**           | 0.000***          | 0.000***            |
| 3            | 2.732**              | 1.918                              | 2.191                    | 0.036*                   | 0.035*                 | 0.016*            | 0.002**           | 0.000***          | 0.000***            |
| 6            | 6.388***             | 2.164                              | 3.212**                  | 0.330                    | 0.008**                | 0.000***           | 0.019*            | 0.000***          | 0.000***            |
| 9            | 4.899*               | 0.227                              | 4.125***                 | 0.002**                  | 0.042*                 | 0.001**           | 0.000***          | 0.000***          | 0.000***            |
| 12           | 0.802                | 0.864                              | 0.708                    | 0.259                    | 0.002**                | 0.022*            | 0.001**           | 0.000***          | 0.000***            |

*P ≤ 0.05, **P ≤ 0.01, ***P ≤ 0.001, df = n – 2. SGA - Small for gestational age, AGA - Appropriate for gestational age.
The lower placement of growth curves for waist circumference in symmetric and asymmetric SGA infants of the two genders than their normal AGA and Dutch[22] counterparts reveals significantly compromised auxological attainments which may be due to the lesser accumulation of fat in abdominal region of SGA babies. The magnitude of which was recorded to be more among symmetric SGA babies as their growth curves ran below their asymmetric counterparts throughout infancy [Figures 1 and 2]. This may be related to continuation of effect of nutritional insult suffered by symmetric SGA babies during early phase of prenatal life than the asymmetric SGA infants who are known to be affected during the last trimester of pregnancy.

The lower placement of growth curves for hip circumference of both male and female symmetric and asymmetric SGA infants than their normal AGA and Dutch[22] infants reveals that, in contrast to their normal peers, growth attainments of our SGA babies were found to be significantly retarded [Figures 3 and 4]. Interestingly, hip circumference measuring similar at 1 month and marginally more at 3 months measured smaller thereafter in asymmetric SGA male babies. This depicts a complete reversal of trend what could be obtained for waist circumference. As compared to male symmetric and asymmetric SGA infants who almost exhibited close similarity in the pattern of their growth for hip circumference, the curve plotted for symmetric SGA female infants not only ran above their asymmetric counterparts but also the magnitude of growth differential increased slowly with the advancement of age to become significant by 12 months. However, at present, no reasons could be offered to explain this trend, but the possibility of relative accumulation of fat over hips of symmetric SGA infants than asymmetric ones could not be excluded. The substantially higher attainments recorded among our AGA infants than their Dutch counterparts beyond 3 months of age reveals that our AGA infants of Indian origin, in general, appear to possess broader hips even than their peers from the developed Western world. This differential besides being inter-racial in origin also appears to infer a tendency of Indian infants to accumulate a greater amount of fat in the gluteal region than their Dutch counterparts.

**Waist–hip ratio**

The waist circumference/hip circumference ratio (WHR) experienced a regular decrease in mean attainments during the first half of infancy than latter one [Figure 5]. WHR among two types and sexes of SGA babies, in general, measured significantly more than their AGA counterparts who, in turn, pattern-wise, have also shown a close resemblance to the normal infants of Dutch origin. This confirms the accumulation of more fat in the visceral region of SGA babies than their AGA counterparts. WHR among our male and female asymmetric SGA babies remained higher than the symmetric SGA infants. This shows more accumulation of abdominal fat in asymmetric infants than the symmetric ones. The tendency of SGA children to be viscerally adipose and hypoadiponectinemic, irrespective of their even being not overweight, has also been reported.[23] A tendency for low birth weight infants to be associated with higher waist-to-hip circumference ratio as compared to their AGA counterparts has also been documented.[24-27] However, findings of Reinehr et al.,[28] that waist circumference and waist-to-hip circumference ratio did not differ among SGA, AGA, and large for gestational age children remain at variance with our results.

**Conclusions**

The poorer postnatal auxological attainments for waist and hip circumference of both types and gender of SGA infants as compared to normal infants suggest the persistence of influence of nutritional insult experienced by these babies during intrauterine period in their 1st year of life. While the higher WHR noticed among SGA infants may be a predisposing factor for the development of central/truncal obesity in later phase of their life and tendency for same appear to be more among asymmetric SGA infants who possess higher WHR than their symmetric SGA counterparts.

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**Conflicts of interest**

There are no conflicts of interest.
References

1. Heptulla R, Smitten A, Teague B, Tamborlane WV, Ma YZ, Caprio S. Temporal patterns of circulating leptin levels in lean and obese adolescents: Relationships to insulin, growth hormone, and free fatty acids rhythmicity. J Clin Endocrinol Metab 2001;86:90-6.
2. Barker DJ, Winter PD, Osmond C, Margetts B, Simmonds SJ. Weight in infancy and death from ischaemic heart disease. Lancet 1989;2:577-80.
3. Hales CN, Barker DJ. Type 2 (non-insulin-dependent) diabetes mellitus: The thrifty phenotype hypothesis. Diabetologia 1992;35:595-601.
4. Phipps K, Barker DJ, Hales CN, Fall CH, Osmond C, Clark PM. Fetal growth and impaired glucose tolerance in men and women. Diabetologia 1993;36:225-8.
5. Lottenberg SA, Glezer A, Turatti LA. Metabolic syndrome: Identifying the risk factors. J Pediatr (Rio J) 2007;83:5204-8.
6. Crume TL, Scherzinger A, Stamm E, McDuffie R, Bischoff KJ, Hamman RF, et al. The long-term impact of intrauterine growth restriction in a diverse U.S. Cohort of children: The EPOCH study. Obesity (Silver Spring) 2014;22:608-15.
7. Kramer MS, Martin RM, Bogdanovich N, Vilchuk K, Dahhou M, Oken E. Is restricted fetal growth associated with later adiposity? Observational analysis of a randomized trial. Am J Clin Nutr 2014;100:176-81.
8. Oken E, Gillman MW. Fetal origins of obesity. Obes Res 2003;11:496-506.
9. World Health Organization. Obesity: Preventing and Managing the Global Epidemic Report of a WHO Consultation (WHO Technical Report Series 894). Chandigarh: World Health Organization; 1999
10. Björntorp P. Classification of obese patients and complications related to the distribution of surplus fat. Am J Clin Nutr 1987;45:1120-5.
11. Huxley R, Mendis S, Zheleznyakov E, Reddy S, Chan J. Body mass index, waist circumference and waist: Hip ratio as predictors of cardiovascular risk – A review of the literature. Eur J Clin Nutr 2010;64:16-22.
12. Aggarwal OP, Bhasin SK, Sharma AK, Chhabra P, Aggarwal K, Rajoura OP. A new instrument (scale) for measuring the socioeconomic status of a family. Indian J Community Med 2005;30:111-4.
13. Lubchenco LO, Hansman C, Dressler M, Boyd E. Intrauterine growth as estimated from liveborn birth-weight data at 24 to 42 weeks of gestation. Pediatrics 1963;32:793-800.
14. Walthier FJ, Ramaekers LH. Neonatal morbidity of S.G.A. Infants in relation to their nutritional status at birth. Acta Paediatr Scand 1982;71:437-40.
15. Bakketeg I.S. Current growth standards, definitions, diagnosis and classification of fetal growth retardation. Eur J Clin Nutr 1998;52 Suppl 1:S1-4.
16. Kaur H, Bhalla AK, Kumar P. Longitudinal growth of head circumference in term symmetric and asymmetric small for gestational age infants. Early Hum Dev 2012;88:473-8.
17. Kaur H, Bhalla AK, Kumar P. Longitudinal growth dynamics of term symmetric and asymmetric small for gestational age infants. Anthropol Anz 2017;74:25-37.
18. World Health Organization. Waist Circumference and Waist-Hip Ratio Report of a WHO Expert Consultation. Geneva: World Health Organization; 2008. p. 8-11.
19. Tanner JM. Some notes on the reporting of growth data. Hum Biol 1951;23:93-159.
20. Esmaillzadeh A, Mirmiran P, Azizi F. Waist-to-hip ratio is a better screening measure for cardiovascular risk factors than other anthropometric indicators in Tehranian adult men. Int J Obes Relat Metab Disord 2004;28:1325-32.
21. Seidell JC, Han TS, Feskens EJ, Lean ME. Narrow hips and broad waist circumferences independently contribute to increased risk of non-insulin-dependent diabetes mellitus. J Intern Med 1997;242:401-6.
22. Fredriks AM, van Buuren S, Fekkes M, Verloove-Vanhorick SP, Wit JM. Are age references for waist circumference, hip circumference and waist-hip ratio in Dutch children useful in clinical practice? Eur J Pediatr 2005;164:216-22.
23. Ibáñez L., Lopez-Bermejo A, Suárez L, Marcos MV, Díaz M, de Zegher F. Visceral adiposity without overweight in children born small for gestational age. J Clin Endocrinol Metab 2008;93:2079-83.
24. Fall CH, Osmond C, Barker DJ, Clark PM, Hales CN, Stirling Y, et al. Fetal and infant growth and cardiovascular risk factors in women. BMJ 1995;310:428-32.
25. Li H, Stein AD, Barnhart HX, Ramakrishnan U, Martorell R. Associations between prenatal and postnatal growth and adult body size and composition. Am J Clin Nutr 2003;77:1498-505.
26. Eusser AM, Finken MJ, Keijzer-Veen MG, Hille ET, Wit JM, Dekker FW, et al. Associations between prenatal and infancy weight gain and BMI, fat mass, and fat distribution in young adulthood: A prospective cohort study in males and females born very preterm. Am J Clin Nutr 2005;81:480-7.
27. Välimäe M, Danylaite A, Kryziūtė D, Ramanauskaitė G, Lasiene D, Lasas L, et al. Postnatal growth in children born small and appropriate for gestational age during the first years of life. Medicina (Kaunas) 2009;45:51-60.
28. Reinehr T, Kleber M, Toschke AM. Small for gestational age status is associated with metabolic syndrome in overweight children. Eur J Endocrinol 2009;160:579-84.