ORIGINAL ARTICLE

Age limitation on provision of orthopedic therapy and orthognathic surgery

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Canadian orthodontists were surveyed by mail to determine the latest skeletal age at which they would recommend orthopedic therapy and orthognathic surgery and the earliest at which they would recommend orthognathic surgery. For the purposes of this introductory study, orthopedic therapy implied stimulation of physiologic response using appliance force, without specification of appliance type. Response rate from 512 orthodontists was 65% ($n = 334$), with the response rate by item varying from 92% to 95%. By Greulich and Pyle standards, the latest recommended age for orthopedic therapy was at 97% completion of skeletal growth (females 13.5 years, males 15 years), whereas the earliest recommended age for orthognathic surgery was when skeletal growth is 99% complete (females 14.9 years, males 16.5 years). Surgery would be recommended by 32% of respondents for a patient before the age of 8 years, if deformity is severe. For orthognathic surgery, respondents either perceived no age maximum or recommended 69 years, the maximum age on the questionnaire item. Orthodontists' traits influenced recommendations for timing treatment. (Am J Orthod Dentofacial Orthop 1998;113:156-64.)

Abnormal dental relationships may be corrected by orthopedic therapy, the application of orthodontic appliance pressure to elicit bone remodeling, or by orthognathic surgery, the surgical repositioning of jaw segments.

Patient age appears to influence orthodontists' treatment recommendations for orthopedic therapy and orthognathic surgery. If orthopedic therapy relies on growth inhibition or promotion at sutures,[1] then growth is prerequisite to the success of treatment. The stage in a patient's development at which treatment is most successful is a controversial issue, because chronologic and dental age are as important to some practitioners as skeletal age is to others.[2,3] Surgeons who recommend orthognathic surgery for children with facial deformities may be concerned about whether the surgery will adversely affect future facial skeletal growth.[4] Occlusal changes due to postpubertal growth[5-7] concern orthodontists who provide orthodontics in combination with orthognathic surgery for the adolescent or young adult patient. Response to surgery[8] and age-related soft tissue changes[9] may affect treatment planning for the older adult orthognathic surgery patient.

There is no absolute consensus about age limits on orthopedic therapy or orthognathic surgery. The purpose of this study was to determine orthodontists' perceptions of skeletal age limits on orthopedic therapy and orthognathic surgery.

MATERIALS AND METHODS

On the basis of a literature review and interviews with four orthodontic graduate students and two orthodontic faculty,[10] age was identified as a potential influence on orthodontists' treatment recommendations. By using a previously described survey method,[11] a 45-minute questionnaire was constructed and administered. Appendix 1 contains age-related items from the questionnaire. Because of the broad scope of the study, items were not subdivided by type of orthopedic therapy or skeletal dysplasia. To reduce the influence of individual variation in timing of the growth spurt, skeletal age was specified for orthopedic therapy and earliest orthognathic surgery. Additional items, included for the purpose of comparison, related to demographics of the respondent orthodontists.

The population surveyed consisted of Canadian orth-

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odontists licensed in 1991, including some retired and excluding six involved with study development.

Initial mailing consisted of an introductory letter and the questionnaire. One week later a postcard response reminder was mailed. Three weeks later a reminder letter and repeat questionnaire were mailed. Follow-ups were sent to nonrespondents, identified by preassigned number. Further investigation and follow-up were performed in the event of a wrong address.[11]

Data entry verification was performed on a randomly selected 20% of the questionnaires.

Comparisons between groups were made by chi-square and *t* tests. Because of repeated testing, the level of probability chosen was $p < 0.01$.

Age Categorization

For the purposes of this study, the following age categories were defined:

1. Normal peak height velocity: From onset of the pubertal growth spurt to normal peak height velocity for a child of average growth tempo.[12]
2. Late peak height velocity: Year of peak height velocity for late maturing persons and decelerating height velocity for children of average growth tempo.[12]
3. Deceleration: A period of decelerating height velocity but still noticeable whole-year height increase for both normal and late maturers.[12]
4. Adult growth: A period when whole-year height increase is negligible,[12] normal maturing females and males have both reached 99.6% completion of growth in height,[13] and adult cranial size increase rather than active growth increase is expected.[14]

The first three categories are referred to collectively as "circumpubertal growth." Associated ages are given in Table I.

Table I. Age categorization (years)

Age category	*Gender*	
	Female	*Male*
Circumpubertal growth (CG)		
Normal peak height velocity (NPHV)	10-12	12-14
Late peak height velocity (LPHV)	13	15
Deceleration (D)	14-15	16-17
Adult growth (AG)	16-18	18-20

RESULTS

Response Rate

Effective mailing (initial mailing minus wrong addresses) totaled 512. Within 5 months of initial mailing, 334 responses (65%) were received. Because of the partial completion of questionnaires, the response rate varied by item from 92% to 95%. There was no data entry error for the 20% of questionnaires verified.

Latest Feasible Orthopedic Therapy

Table II shows response distribution for orthodontists who recommended orthopedic therapy before age 18 years. Mean response frequency was age 13.5 and 15 years, respectively, for female and male patients. Responses were infrequent for the "adult growth" category, and only 3% of orthodontists thought that orthopedic therapy is feasible after age 18 years for either a female or male patient. When ages were categorized as normal peak height velocity, late peak height velocity, deceleration, and adult growth and comparisons made between genders, there were no significant differences.

Earliest Feasible Orthognathic Surgery

Table III shows response distribution for the earliest skeletal age at which surgery was recommended for patients. Mean response frequency was age 14.9 years for female patients and 16.3 years for male patients. Comparison between age categories revealed no significant gender differences. Even given the possibility of congenital birth defect, only 32% of orthodontists thought surgery was an option before age 8 years.

Latest Feasible Orthognathic Surgery

For the 51% of orthodontists who specified an age limit in the multiresponse item concerning latest feasible orthognathic surgery, Table IV shows response distribution. Comparisons between age categories revealed no significant gender differences, and 50 to 64 years was the preferred upper age limit for orthodontists who specified a limit.

Timing of Orthopedic Therapy Versus Orthognathic Surgery

Latest orthopedic therapy was recommended significantly earlier than earliest orthognathic surgery (13.5 versus 14.9 years for females and 15.0 versus 16.3 years for males, $p < 0.001$).

Interaction Between Orthodontist Demographic and Treatment Timing

The interaction between orthodontists' experience, nature of practice and educational qualifications, and their perceptions regarding latest feasible orthopedic therapy is provided in Tables V (female patient) and VI (male patient). For females, there was a significant difference ($p < 0.002$) between

Table II. Latest feasible orthopedic therapy selected by orthodontists (n (%))

Gender	*Age category*				*Significance*	*Total*
	NPHV	*LPHV*	*D*	*AG*		
Female	68 (23)	94 (31)	113 (38)	25 (8)	NS	300
Male	95 (32)	85 (29)	93 (31)	22 (7)		295

NS: Not significant.

Table III. Earliest feasible orthognathic surgery selected by orthodontists (n (%))

Gender	*Age category*		*Significance*
	CG	*AG*	
Female	167 (60)	112 (40)	NS
Male	168 (61)	107 (39)	

NS: Not significant.

Table IV. Latest feasible orthognathic surgery selected by orthodontists (n (%))

Gender	*Age (years)*				*Significance*	*Total*
	<50	*50-54*	*55-59*	*≥60*		
Female	28 (18)	40 (26)	30 (20)	55 (36)	NS	153
Male	28 (18)	40 (26)	32 (21)	53 (35)		153

NS: Not significant.

Table V. Latest orthopedic therapy for female patients by orthodontist demographic (n (%))

Orthodontist demographic	*Age category*				*Significance*
	NPHV	*LPHV*[1]	*D*	*AG*	
Experience (years)					
0-14	36 (22)	55 (33)	66 (40)	10 (6)	
15-25	26 (27)	30 (31)	33 (34)	7 (7)	NS
26-41	6 (16)	9 (24)	14 (38)	8 (22)	
Work pattern					
Part-time	11 (24)	9 (20)	15 (33)	10 (22)	$p < 0.002$
Full-time	57 (22)	85 (33)	98 (38)	15 (6)	
Practice type					
Private	62 (24)	77 (30)	94 (37)	22 (9)	NS
Academic	7 (16)	16 (36)	19 (42)	3 (7)	
Diploma					
No	15 (18)	26 (31)	36 (42)	8 (9)	NS
Yes	53 (25)	68 (32)	77 (36)	17 (8)	
Masters					
No	36 (24)	49 (33)	49 (33)	15 (10)	NS
Yes	32 (21)	45 (30)	64 (42)	10 (7)	

[1]Mean response of 13.5 years corresponded to this age category.
NS: Not significant.

part-time and full-time orthodontists, with part-timers being more likely to suggest later feasibility of orthopedic therapy. Orthodontists' traits otherwise did not significantly influence timing of orthopedic therapy for female patients. Years of experience as an orthodontist, part-time versus full-time practice, private practice versus academia, and diploma versus masters level education did not significantly affect latest recommended orthopedic therapy for male patients.

Table VI. Latest orthopedic therapy for male patients by orthodontist demographic (n (%))

Orthodontist demographic	Age category				Significance
	NPHV	LPHV[1]	D	AG	
Experience (years)					
0-14	60 (37)	49 (30)	43 (26)	12 (7)	
15-25	29 (31)	27 (28)	34 (36)	5 (5)	NS
26-41	6 (17)	9 (25)	16 (44)	5 (14)	
Work pattern					
Part-time	10 (23)	11 (25)	18 (41)	5 (11)	NS
Full-time	85 (34)	74 (29)	75 (30)	17 (7)	
Practice type					
Private practice	86 (34)	68 (27)	75 (30)	21 (8)	NS
Academic	9 (20)	17 (38)	18 (40)	1 (2)	
Diploma					
No	18 (22)	28 (34)	31 (37)	6 (7)	S
Yes	76 (36)	58 (27)	62 (29)	16 (8)	
Masters					
No	54 (37)	37 (25)	44 (30)	12 (8)	NS
Yes	40 (27)	49 (33)	49 (33)	10 (7)	

[1]Mean response of 15 years corresponded to this age category.
NS: Not significant.

Table VII. Earliest orthognathic surgery for female patients by orthodontist demographic (n (%))

Orthodontist demographic	Age category		Significance
	CG	AG	
Experience (years)			
0-14	99 (65)	54 (35)	
15-25	53 (58)	39 (42)	NS
26-41	15 (44)	19 (56)	
Work pattern			
Part-time	21 (51)	20 (49)	NS
Full-time	145 (61)	93 (39)	
Practice type			
Private practice	145 (60)	95 (40)	NS
Academic	21 (51)	20 (49)	
Diploma			
No	56 (69)	25 (31)	NS
Yes	110 (56)	88 (44)	
Masters			
No	70 (51)	68 (49)	$p < 0.003$
Yes	96 (68)	45 (32)	

NOTE. Mean response of 14.9 years corresponded to the deceleration category.
NS: Not significant.

The interaction between orthodontists' experience, nature of practice and educational qualifications, and their perceptions regarding earliest feasible orthognathic surgery is shown in Tables VII (female patient) and VIII (male patient). For female patients, there was a significant difference between orthodontists with and without a masters degree ($p < 0.01$) in recommendation regarding earliest orthognathic surgery. Those with a masters degree were more likely to suggest a younger age for earliest feasible surgery. For male patients, there was a significant difference ($p < 0.01$) between orthodontists, based on experience and private practice versus academia. The more experienced orthodontist and the academic were more likely to suggest an older age for earliest feasible surgery. No other traits significantly influenced suggested earliest feasible surgery.

Tables IX (female patient) and X (male patient) show the interaction between orthodontists' traits

Table VIII. Earliest orthognathic surgery for male patients by orthodontist demographic (n (%))

Orthodontist demographic	*Age category*		*Significance*
	CG	*AG*	
Experience (years)			
0-14	102 (68)	48 (32)	
15-25	53 (57)	40 (43)	$p < 0.01$
26-41	13 (41)	19 (59)	
Work pattern			
Part-time	19 (48)	21 (52)	NS
Full-time	149 (63)	86 (37)	
Practice type			
Private practice	150 (64)	84 (36)	$p < 0.01$
Academic	17 (41)	24 (59)	
Diploma			
No	54 (68)	26 (32)	NS
Yes	113 (58)	82 (42)	
Masters			
No	78 (58)	57 (42)	NS
Yes	89 (64)	51 (36)	

NOTE: Mean response of 16.3 years corresponded to the deceleration category.
NS: Not significant.

Table IX. Latest orthognathic surgery for female patients by orthodontist demographic (n (%))

Orthodontist demographic	*Age (years)*				*Significance*
	<50	*50-54*	*55-59*	*≥60*	
Experience (years)					
0-14	14 (17)	23 (28)	17 (21)	28 (34)	
15-25	6 (15)	14 (34)	11 (27)	10 (24)	NS
26-41	8 (36)	3 (14)	2 (9)	9 (41)	
Work pattern					
Part-time	3 (15)	5 (25)	2 (10)	10 (50)	NS
Full-time	25 (18)	40 (29)	28 (21)	43 (32)	
Practice type					
Private practice	27 (20)	37 (28)	26 (19)	46 (34)	NS
Academic	1 (6)	3 (18)	4 (24)	1 (53)	
Diploma					
No	5 (12)	10 (24)	6 (15)	20 (48)	NS
Yes	23 (21)	30 (27)	23 (21)	35 (32)	
Masters					
No	22 (28)	17 (22)	16 (21)	23 (29)	$p < 0.008$
Yes	6 (9)	23 (36)	13 (20)	32 (50)	

NS: Not significant.

and their perceptions of latest feasible orthognathic surgery. There was a significant difference for both female and male patients ($p < 0.01$) when orthodontists with a masters degree are compared with those without. Those with a masters degree are more likely to suggest that orthognathic surgery can be performed after age 60 years. Years of experience as an orthodontist, part-time versus full-time practice, private practice versus academia, and diploma versus nondiploma level education did not significantly affect perception of latest feasible orthognathic surgery for female or male patients.

DISCUSSION

This survey research gives insight into the age range over which orthopedic therapy and orthognathic surgery are provided. The ranges reflect variation between individual or intraindividual conflicts between skeletal, dental, and chronologic ages. Knowledge of recommended (subjective) age limitations allows comparison to age limitations suggested by long-term outcome measures (objective). Discrepancies between subjective and objective recommendations motivates further research or closer perusal of the existing research and enhances deter-

Table X. Latest orthognathic surgery for male patients by orthodontist demographic (n (%))

Orthodontist demographic	Age (years)				Significance
	<50	50-54	55-59	≥60	
Experience (years)					
0-14	15 (18)	21 (26)	17 (21)	29 (35)	
15-25	6 (12)	14 (29)	12 (24)	17 (35)	NS
26-41	7 (32)	5 (23)	3 (14)	7 (32)	
Work pattern					
Part-time	3 (15)	7 (35)	2 (10)	8 (40)	NS
Full-time	25 (19)	33 (25)	30 (23)	43 (33)	
Practice type					
Private practice	27 (20)	37 (27)	28 (21)	44 (32)	NS
Academic	1 (6)	3 (18)	4 (24)	9 (53)	
Diploma					
No	5 (12)	11 (27)	5 (12)	20 (49)	NS
Yes	28 (24)	29 (25)	26 (22)	33 (28)	
Masters					
No	22 (28)	15 (19)	18 (23)	23 (29)	$p < 0.004$
Yes	6 (8)	25 (34)	13 (18)	32 (41)	

NS: Not significant.

mination of education and continuing education needs within the specialty. If consensus can be built regarding timing of orthopedic therapy, perhaps pressure to treat patients at the same chronologic age as their peers can be reduced, so that treatment is instead provided at the appropriate skeletal age. Knowing how our own traits influence timing of treatment may help us plan treatment more objectively.

The mean response of 13.5 years for female patients and 15 years for male patients suggested that orthopedic therapy would still be recommended during a period of decreasing growth velocity.[12] These higher-than-expected ages may reflect respondents' averaging of rapid palatal expansion with other types of orthopedic therapy. The recommended age for latest orthopedic therapy coincides with 97% completion of skeletal growth or remaining growth in height of 3.8 cm for female patients and 5.1 cm for male patients.[13] The female age of 13.5 years is close to or slightly higher than the most common menarcheal age.[15-17] Absence of significant gender differences when responses were categorized by age indicates that orthodontists were very sensitive to the typical 2-year difference of the time of the growth spurt between female and male patients.[12]

Depending on treatment modality, chronologic age for provision of orthopedic therapy ranges from 7 to 13 years (female)[18,19] or 14 years (male)[20] for patients with Class II malocclusion, 4 to 13.8 years (female)[21-23] or 15 years (male)[24] for patients with Class III malocclusion, and 6.3 years (female) or 6.8 years (male)[25] to 30 for patients with transverse maxillary constriction.[26] Response range for latest recommended orthopedic therapy was consistent both with the literature and with individual variation in maturation.[12,27] Mean response frequency was consistent with the upper age limits in the literature, except for late maxillary expansion. Age restrictions on orthopedic therapy were more stringent than on early or late surgery, because most respondents did not believe orthopedic therapy to be possible beyond age 18 years. Positive responses for feasibility of orthopedic therapy for male patients at age 18 years and for female and male patients beyond the age 18 years may have been influenced by respondent perception of factors related to individual patient variation, including delayed maturation, late mandibular growth,[5,6] or late ossification of the median palatine suture.[28]

Mean response frequency for earliest recommended surgery coincided with decelerating growth,[12] which is 99% complete (remaining growth in height of 1.3 cm for female and 2.5 cm for male patients).[13] Except for respondents recommending surgery after age 20 years (2% females and 8% males), earliest surgery was not postponed until after late mandibular growth, which is still occurring between the chronologic ages of 14 and 20 years for female patients[5] and 16 and 20 years for male patients.[6] Nor was surgery postponed until after completion of postpubertal soft tissue facial growth changes.[29] This behavior is consistent with Snow's findings[7] that late growth changes do not affect the stability of adolescent surgical changes.

The significant interval between latest orthope-

dic therapy and earliest surgery may reflect the time required to attain greater skeletal maturity (99% versus 97% completion) or time to perform presurgical orthodontics. The validity of this time interval might be questioned by Snow et al.[7] as their subjects underwent surgery at age 13.7 years for female patients and 14.8 years for male patients, very close to the age for latest feasible orthopedic therapy found in this study. The postsurgical increase in mandibular length of 1.1 mm/year for female patients and 1.8 mm/year for male patients did not affect dental relationship in their cases after a 3-year follow-up. Snow et al. believed there were psychological and practical advantages associated with surgery in adolescence, and that the risk of relapse could be minimized by retaining with a functional appliance. Our respondents may have found that the uncertainty related to individual variation in postsurgical growth was not enough to preclude surgery in adolescence, but they were not prepared to cope with as much postsurgical growth as Snow et al.

Bollen and Hujoel[30] demonstrated a surgical group of patients with Class II malocclusion to be 7 years older than a camouflage group. Although they thought that skeletal configuration determined treatment recommendation, they postulated that orthodontists might be hoping for skeletal changes in the younger postmenarcheal patient. (There is potential for postmenarcheal growth of up to 3.5 cm in the 61% of female patients with open epiphyses in the first postmenarcheal year.)[31] Although the mean age of the camouflage group (18 years) was within the range at which late growth might still occur,[5] it was above the age where self-correction could be expected and well above the age found in this study for earliest recommended surgery. The 7-year difference between Bollen and Hujoel's surgical and camouflage patients is consistent with, albeit much larger than, the 15-month difference between latest orthopedic therapy and earliest surgery in this study. It seems unlikely that methodologic differences alone (clinical retrospective versus report of perception) would account for such a discrepancy between the two studies.

A third of the orthodontists who would recommend orthognathic surgery before age 8 years for severe deformity are in agreement with researchers who show no adverse effect of orthognathic surgery over remaining facial skeletal growth.[4] However, the size of this minority suggests lack of consensus concerning the advantages of very early surgery. Freihofer et al.[32] suggest that timing is specific to both procedure and deformity.

Completion of circumpubertal growth eliminated gender-dependent age differences and made age restrictions less stringent, because about half of the sample put no limit on late surgery. Orthodontists may not experience problems with short-term adverse esthetic results, based on patients' age-related soft tissue changes.[9] Perhaps facial structural changes found to occur between ages 18 and 42 years[33] do not have significant clinical impact, or patients are not observed for long enough after treatment for the orthodontist to observe age-related changes. The orthodontist may perceive that the older patient is as good a candidate for orthognathic surgery as a younger patient, but with different adjunctive cosmetic surgery requirements. Willingness to suggest surgery for older patients is consistent with increasing frequency of adult orthognathic surgery.[34]

This study does not explain why certain traits of orthodontists affected timing of orthopedic therapy or orthognathic surgery. Perhaps educational history or type of employment affect the types of patients orthodontists attract and thus affect their conclusions, based on clinical experiences. Orthodontists' behaviors may also relate to the interaction between their traits. For instance, if the requirement to complete a masters degree has increased in recent years, then less experienced orthodontists with masters degrees may have been influenced by practicing in an era when surgery is performed more commonly.[34]

Conclusions must be tempered somewhat by limitations of the study. Differences in training and demographics between respondents and nonrespondents could not be determined because of confidentiality measures. Because the results were a small part of a broad scope survey, reliability could not be tested. Some respondents commented they would have responded differently for skeletal Class II and III patients, implying the questions were too general. Given response for male latest growth modification and male or female earliest orthognathic surgery, the range of possible responses could have been increased. Questions could have been phrased to clarify whether respondents would start or finish orthopedic therapy at the recommended age and whether they would do presurgical orthodontics or surgery at that age.

Some questions raised by this study warrant further research. It would be interesting to determine: (1) to what degree chronologic and dental age influence treatment; (2) what method of skeletal age assessment is preferred if treatment decisions are

based primarily on skeletal age; (3) whether accuracy of skeletal age assessment affects the age at which certain procedures are performed; and (4) the incidence of complications resulting from growth changes in the young surgical patient and to loss of tissue elasticity in the older surgical patient.

CONCLUSIONS

As expected, patient age influences orthodontists' recommendations regarding timing of orthopedic therapy and orthognathic surgery. Latest recommended orthopedic therapy occurred at mean 97% completion of skeletal growth. The 2% maturation interval between latest orthopedic therapy and earliest surgery may give time to allow late mandibular growth or presurgical orthodontics. Half of the respondents put no age limitation on latest orthognathic surgery. Where a limit was specified, the most extreme available response was often selected (65 to 69 years). This information may provide orthodontists with insight regarding timing age-sensitive procedures. The older patient may be reassured that surgical treatment options will be presented to them.

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APPENDIX 1

C1. Please indicate the *one* average *skeletal* age (in years) *after* which you would *NO LONGER consider growth modification* a treatment option for the young patient:

if the patient is MALE. . .

[ ] 8 [ ] 9 [ ] 10 [ ] 11 [ ] 12 [ ] 13
[ ] 14 [ ] 15 [ ] 16 [ ] 17 [ ] 18

if the patient is FEMALE. . .

[ ] 8 [ ] 9 [ ] 10 [ ] 11 [ ] 12 [ ] 13
[ ] 14 [ ] 15 [ ] 16 [ ] 17 [ ] 18

or. . .

[ ] orthopedic changes can be obtained beyond age 18 for a patient of either sex

C2. Please indicate the *one earliest* average *skeletal* age (in years) at which you would *consider orthognathic surgery* a treatment option for the young patient:

if the patient is FEMALE. . .

[ ] 8 [ ] 9 [ ] 10 [ ] 11 [ ] 12 [ ] 13
[ ] 14 [ ] 15 [ ] 16 [ ] 17 [ ] 18 [ ] 19
[ ] 20 [ ] 21 [ ] 22 [ ] 23 [ ] 24 [ ] 25

if the patient is MALE. . .

[ ] 8 [ ] 9 [ ] 10 [ ] 11 [ ] 12 [ ] 13
[ ] 14 [ ] 15 [ ] 16 [ ] 17 [ ] 18 [ ] 19
[ ] 20 [ ] 21 [ ] 22 [ ] 23 [ ] 24 [ ] 25

additionally. . .

[ ] orthognathic surgery is a good option before age 8 in a patient of either sex given sufficient severity of the problem (eg. congenital birth defect)

C3. Please indicate the *one* average *chronological age range after* which you would *NOT recommend orthognathic surgery* for the older patient:

if the patient is MALE. . .

[ ] *30*-34 [ ] *35*-39 [ ] *40*-44 [ ] *45*-49
[ ] *50*-54 [ ] *55*-59 [ ] *60*-64 [ ] *65*-69

if the patient is FEMALE. . .

[ ] *30*-34 [ ] *35*-39 [ ] *40*-44 [ ] *45*-49
[ ] *50*-54 [ ] *55*-59 [ ] *60*-64 [ ] *65*-69

or. . .

[ ] age is not a restriction in selecting the surgical option for the older patient of either sex given sufficient severity of the problem