CHAPTER 17 - ONCOLOGY

1 INTRODUCTION

Every pilot who has been treated for malignant disease will need an individual assessment before returning to flying. Recovery from surgery or radiotherapy should be assessed. Current curative or adjuvent chemotherapy is incompatible with certification, and recovery from the effects of these drugs will demand a period of a temporarily unfit assessment after the treatment has finished. If the pilot has recovered from the primary treatment, and, as far as is possible with available techniques, there is no sign of residual tumour, then the level of certification will depend on the likelihood of recurrent disease. This chapter of the guidance material will explore a method of assessing the risk to flight safety from air crew who have received treatment for malignant disease, and then apply that method to the four commonest tumours seen in a pilot population, malignant melanoma, colorectal carcinoma, testicular tumours and lymphoma.

2 PRIMARY TREATMENT FOR MALIGNANT DISEASE

2.1 Surgery

Surgery is the commonest primary treatment for malignant disease, and is often the only treatment. A return to flying, from the purely surgical aspect, depends on the extent of the operation, and this can be conveniently broken down into minor, intermediate and major surgery. Examples of minimum times assessed as temporarily unfit for various types of surgery (taken from the tumours presented later) are shown in the table below.

Operation	Example	Minimum time assessed as temporarily unfit
Minor	Excision of mole Lymph node biopsy	1 week
Intermediate	Orchidectomy for testicular tumour	4 weeks
Major	Hemicolectomy for carcinoma of colon	12 weeks

It is stressed that these are minimum times, and any more extensive procedures, or any complications with, for example, wound healing will extend these times.

The AMS may consider earlier recertification if recovery is complete, the applicant is asymptomatic and there is a minimal risk of further complication.

2.2 Radiotherapy

Radiotherapy treatment for malignant disease is usually given as an intensive course. The aim of this may be curative, for example to an isolated group of lymph nodes which have proved by biopsy to contain lymphoma; or as adjuvent treatment, for example to the abdominal nodes following orchidectomy for a seminoma of the testis, on the assumption that they may contain metastatic tumour. Since most courses are intensive, there is little time to fly even if the pilot wished to, but many patients undergoing radiotherapy suffer non-specific systemic effects (tiredness, malaise and nausea) which make it inadvisable for any pilot to fly whilst receiving this treatment. Apart from physical symptoms there are often psychological effects and worries associated with radiotherapy, which, in common with chemotherapy, may also affect flying ability.

2.3 **Chemotherapy**

Pilots should be assessed as temporarily unfit during any treatment with chemotherapy. All these drugs are toxic to normal cells, and in particular to rapidly dividing cells in the bone marrow. During chemotherapy the patient is routinely tested for normal blood levels such as haemoglobin, and this should serve as a reminder both to the pilot and his AME that there are potential risks if he enters a hypoxic environment. A temporarily unfit assessment applies to curative chemotherapy, for example in the treatment of disseminated lymphoma, and also to adjuvent chemotherapy, for example in drugs given to prevent the possible recurrence of colorectal cancer following surgical excision. The latter treatment may extend over a prolonged period of time, and there may well be a conflict between the 'medical' advice to have the adjuvent treatment and the pilot's desire to regain a medical certificate to fly. The only exception to a temporarily unfit assessment during adjuvent treatment for malignancy is endocrine therapy. Certain adjuvent hormone and anti-hormone treatment following (for example) breast and prostate cancer treatment may be acceptable if there are no side effects.

3 CERTIFICATION AFTER PRIMARY TREATMENT OF A HYPOTHETICAL TUMOUR X

3.1 **Defining acceptable risk**

In this discussion the assumption is made that the primary treatment (be it surgery, radiotherapy, chemotherapy or a combination) has removed all signs of tumour X measured clinically or by investigation. The risk to flight safety is now the possibility that local or metastatic recurrence will cause sudden or subtle incapacitation whilst the pilot is flying or the air traffic controller is controlling an aircraft.

The concept of 'acceptable risk' has been discussed elsewhere, and much work in aviation cardiology has defined a risk of incapacitation of up to 1% per year to be acceptable for two crew professional and unrestricted private flying. This can also be applied to certification after treatment for malignant disease. One difference between cardiology and oncology is that with the former, once the risk has been defined and certification achieved, the pathological condition is not likely to go away. After treatment of malignancy however, the prognosis improves with recurrence free time away from the original episode. Thus to consider the full range of certification possibilities, from no certificate to unrestricted Class 1, and including Class 2 certification for private flying, acceptable incapacitation risk levels have to be defined.

In this discussion the following annual incapacitation risks will be used to define the appropriate certification. It should be noted that the exact levels for restricted Class 2 certification (private flying with a safety pilot) have never been defined. For the purposes of these calculations a 3–5% annual incapacitation risk has been taken as the upper limit.

Risk per year of incapacitation	Acceptable level of certification	Licence
Less than 0·1%	Any	Any
Between 0·1% and 1%	Class 1 restricted ('OML') Class 2 unrestricted	2 crew professional Solo private
Greater than 1%	No Class 1 Possible Class 2 restricted ('OSL')	No professional Private with 'Safety Pilot'

Thus if an incapacitation rate per year can be derived for tumour X at any particular time away from its original treatment, then an acceptable level of certification for that pilot, at that time, can be calculated from the table above.
Following 'successful' primary treatment, the risk that tumour X will cause a subtle or sudden incapacitation depends on two factors. The first is the actual risk of recurrence, which will depend on the pathological stage of the tumour or its TNM classification (Tumour Node Metastasis). The second is the site of that recurrence, and this will depend on the primary tumour type. These two factors will now be discussed individually, again in relation to a hypothetical tumour X.

3.2 **Defining the risk of recurrence**

The annual recurrence rate of tumour X can be calculated from survival curves. Ideally these should be 'recurrence free' survival curves, but those are often not available, and thus simple survival data will need to be used. However, unless it is possible to cure many patients once their tumour has recurred (not a common situation) then the two curves will be very similar in shape. **Figure 1** shows a hypothetical five year survival curve for tumour X, and is used to show the usual representation of this type of data. It includes percentage figures along the curve showing the recurrence rates for each of the five years following treatment.

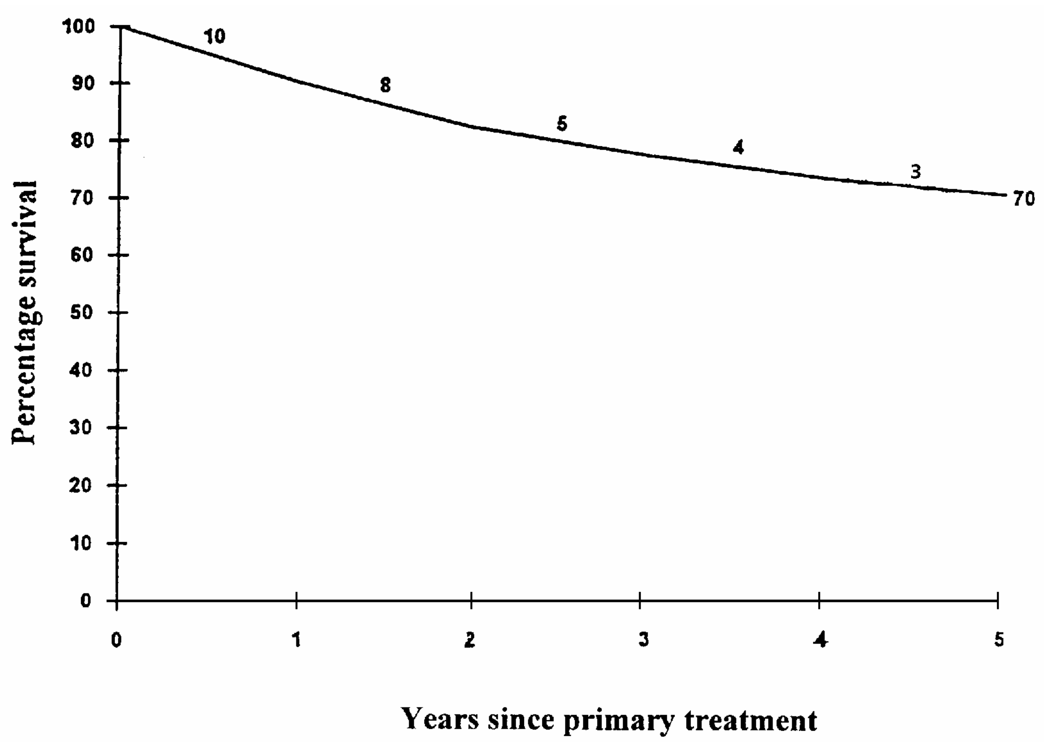

Figure 1: Overall five year survival after primary treatment for tumour X.

The graph represents the recurrence rates for all cases of tumour X. This data however, includes a large spectrum of recurrence rates from very low (early stage disease) to very high (late stage disease). Tumour X lesions can be divided into three types, or stages, based on the pathological examination of the resected specimen. Using the TNM classification, these can be described as stages 1, 2 and 3 as shown in the following table:

TUMOUR X – PATHOLOGY		
Stage	TNM	Description
1	T1 N0	Small tumour, no nodes
2	T2 N0	Larger tumour, no nodes
3	T1/2 N1	Any size tumour, nodes involved

Studies have shown that the prognosis following surgical treatment for tumour X is related positively with the stage of the tumour at operation. Thus the previous overall five year survival curve of tumour X can be broken down into three separate curves relating to the three separate stages as shown in **Figure 2**. As would be expected, the more advanced stage tumours (stage 2 and 3) have a worse prognosis than early lesions.

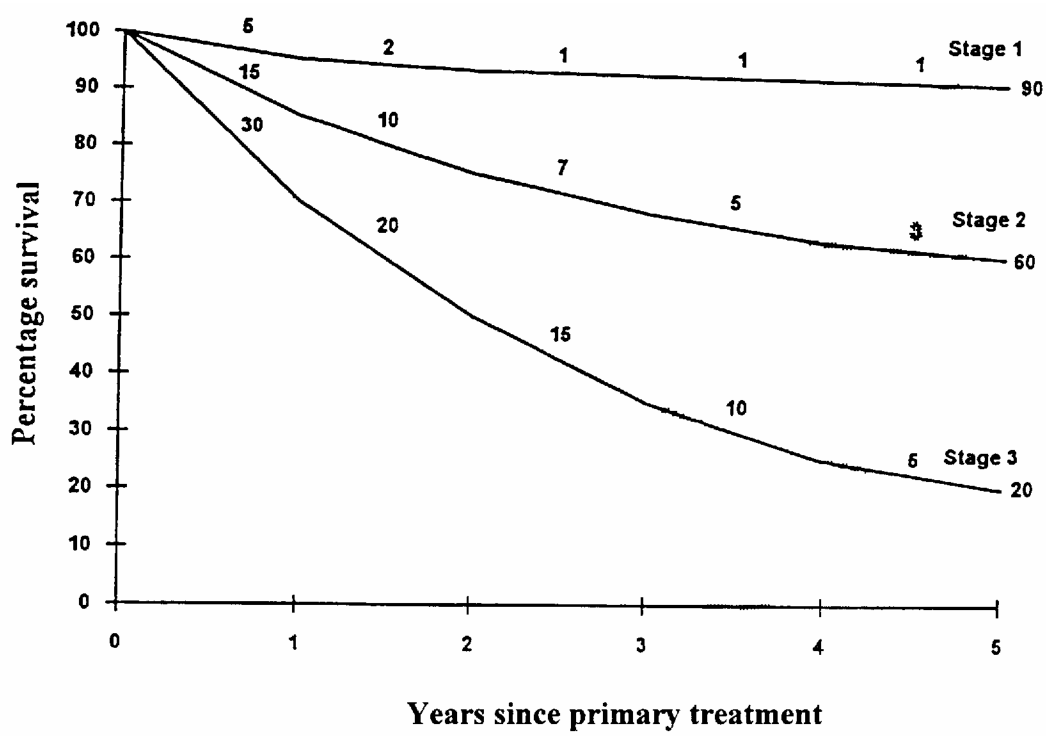

Figure 2: Five year survival for Tumour X divided into pathological stages

From the data in **Figure 2** it is possible to derive a yearly percentage risk of recurrence for any stage of tumour X. For instance, the risk of a recurrence between 2 and 3 years after surgery for a stage 2 tumour is 7%.

3.3 **Defining the site of recurrence**

Each tumour has its own particular sites of recurrence, and these have been recorded in pathology textbooks since pathology textbooks were first written. Although metastases can occur in any part of the body, the majority are found in the organs listed in the following table.

Sites of metastatic disease
Local and lymph nodes
Liver
Lung
Bone
Bone marrow
Brain

Study of the appropriate pathology textbooks shows that tumour X tends to metastasise to the following sites, at the rates below:

Site	Incidence
Local and lymph nodes	60%
Liver	20%
Lung	5%
Bone	5%
Bone marrow	0%
Brain	10%

Ideally this data should relate to the incidence of a ‘first recurrence’ at these sites. This, however, is often difficult to find in the literature. Figures for the incidence of metastases in various organs at post-mortem is more easily obtained, and in some tumours an extrapolation from this data may be necessary to obtain a ‘first recurrence’ incidence.

3.4 Defining the risk of a particular metastasis causing incapacitation

A first recurrence in a regional lymph node carries a very small risk of incapacitation. A brain metastasis however, as the first indication of recurrent disease, must carry a 100% potential for sudden incapacitation in the form of a fit or seizure. Metastatic disease in bone marrow can cause anaemia and bleeding disorders. Rarely metastases may erode major vessels with catastrophic consequences (lung and liver). The risk of subtle incapacitation is harder to quantify, but it must be assumed that any recurrence of any tumour will degrade the operational abilities of air crew or controllers to some extent.

Thus a table of ‘incapacitation weighting’ can be constructed to give a measure of the potential for sudden and subtle incapacitation by a recurrence at each metastatic site. This is shown in the table below.

Site	Incapacitation risk ‘weighting’
Local and lymph nodes	1%
Liver	5%
Lung	5%
Bone	5%
Bone marrow	20%
Brain	100%

3.5 Defining the total risk of incapacitation

Three parameters are now known about tumour X, and these can be used to calculate a ‘total’ risk of incapacitation. They are:

- The recurrence rate per year for any stage of tumour X (as a percentage).
- The frequency of metastatic disease in a particular organ (as a fraction).
- The risk that a metastasis in a particular organ will cause incapacitation (as a fraction).

A formula can now be derived to calculate the total risk of a particular metastasis causing incapacitation. The example below is for brain metastases.

Tumour X recurrence rate (%)	X	Incidence of brain metastases	X	Risk of a brain metastasis causing incapacitation	=	Incapacitation risk for brain metastases in tumour X

Using the figures that we have obtained, numbers can be put to this formula. The tumour recurrence rates per year are from **Figure 2**.

Year 1 / Stage 1 : 5% X 10/100 X 100/100 = 0·5% risk of incapacitation

Year 1 / Stage 2 : 15% X 10/100 X 100/100 = 1·5% risk of incapacitation

Year 1 / Stage 3 : 30% X 10/100 X 100/100 = 3·0% risk of incapacitation

In the first year, therefore, the risk of incapacitation due to brain metastases ranges from 0.5% to 3.0%. This would allow a range of certification as shown in the table below.

YEAR 1 – BRAIN METASTASES			
Stage	Incapacitation risk	Professional certification	Private certification
1	0·5%	‘As or with copilot’	Unrestricted
2	1·5%	None	‘Safety pilot’
3	3·0%	None	‘Safety pilot’

By year 5 the prognosis has improved and so have the incapacitation risks. Again the tumour recurrence rates are taken from **Figure 2**.

Year 5 / Stage 1 : 1% X 10/100 X 100/100 = 0·1% risk of incapacitation

Year 5 / Stage 2 : 3% X 10/100 X 100/100 = 0·3% risk of incapacitation

Year 5 / Stage 3 : 5% X 10/100 X 100/100 = 0·5% risk of incapacitation

In the fifth year the risk of incapacitation has now fallen to between 0·1 and 0·5%. The range of certification has also improved, as shown in the following table.

YEAR 5 – BRAIN METASTASES			
Stage	Incapacitation risk	Professional certification	Private certification
1	Unrestricted	Unrestricted	Unrestricted
2	0·3%	‘As or with co-pilot’	Unrestricted
3	0·5%	‘As or with co-pilot’	Unrestricted

Obviously other types of recurrence are possible (and indeed more likely) than brain metastases, but because of the ‘incapacitation weighting’ given to each anatomical recurrence, brain lesions contribute most to the total risk of incapacitation.

3.6 **Presenting the total risk of incapacitation**

The performance of commercial aircraft (the weights that can be carried in the ambient atmospheric conditions with given runway lengths) are often presented in a series of graphs which take account of the various parameters by altering the slopes and distances (factoring) on the charts. These are called performance charts. Thus one might enter the chart with aircraft weight, traverse various sub-graphs (air temperature, aerodrome altitude, runway slope, headwind component etc), and come out at the other end with the runway length required to take off at that weight.

The same techniques can be used to depict data about tumour recurrence and the risk of incapacitation. The graph can be entered with the time from the original treatment, factored for stage, grade or any other pathological prognostic variable, and then exited with the appropriate certification. This means that individual calculations as done above for each year and stage of tumour X would not be necessary, as they would all be incorporated into the graph. We have called this a ‘certification assessment’ graph.

3.7 **Using certification assessment graphs**

It should be emphasised that these charts are derived from morbidity and mortality statistics. They cannot predict what will happen in an individual pilot or controller. When a medical test is developed which can accurately pinpoint metastatic or recurrent disease, then these charts will be obsolete. Until then they can act as a guide to the aeromedical examiner who is faced with the certification of a pilot who has been treated for malignant disease.

Figure 3 shows a certification assessment graph for tumour X, and the normal ‘movement’ through the graph. Starting on the left hand axis with years since the end of the primary treatment, we move horizontally left to the REFERENCE LINE. If the tumour is stage 2, we move straight across to the right hand axis to read off the appropriate certification. If, however, the tumour is stage 1 or stage 3, the path through the graph has to be ‘factored’ to reflect better or worse prognosis and risk than stage 2. Stage 3, a worse risk, moves up and left before crossing to the right axis, and this greater risk is reflected in a lower certification. Stage 1, however, with the best prognosis, moves down and right before crossing to the right axis, where unrestricted certification is possible.

If we wish to assess when a pilot becomes a low enough risk for unrestricted certification, it is necessary to move from right to left in the graph. In **Figure 4** we wish to know when a pilot who has had treatment for a stage 1 lesion could become eligible for an unrestricted Class 1 certificate. By moving back through the graph from the junction between Class 1 Restricted/Unrestricted line we find that it is 1 year after treatment has finished.

Similarly in **Figure 5** we would like to know when it becomes possible to certificate a pilot with a stage 3 tumour. We move from the No certificate / Class 1 Restricted junction backwards (right to left) in the graph, but going now to the STAGE 3 column first and then to the REFERENCE LINE. We then move to the left hand axis and read that a pilot with a stage 3 lesion will not reach a low enough risk of incapacitation for Class 1 Restricted certification (1% per year risk of incapacitation) until 3 years have passed from the initial treatment.

The rules, therefore, for moving through a 'certification assessment' graph depend on whether we start with a 'time from treatment' on the left hand axis, or from a 'certification level' on the right. Moving left to right we go to the REFERENCE LINE first, then to the appropriate stage (which may be on the reference line) and then across to the certification columns. Moving right to left, we go first to the appropriate stage, and then to the REFERENCE LINE, before moving left to the 'time from treatment' axis. Once it has been used a few times it becomes simpler, just as you found that your aircraft performance charts suddenly made sense.

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Tumour X - certification assessment

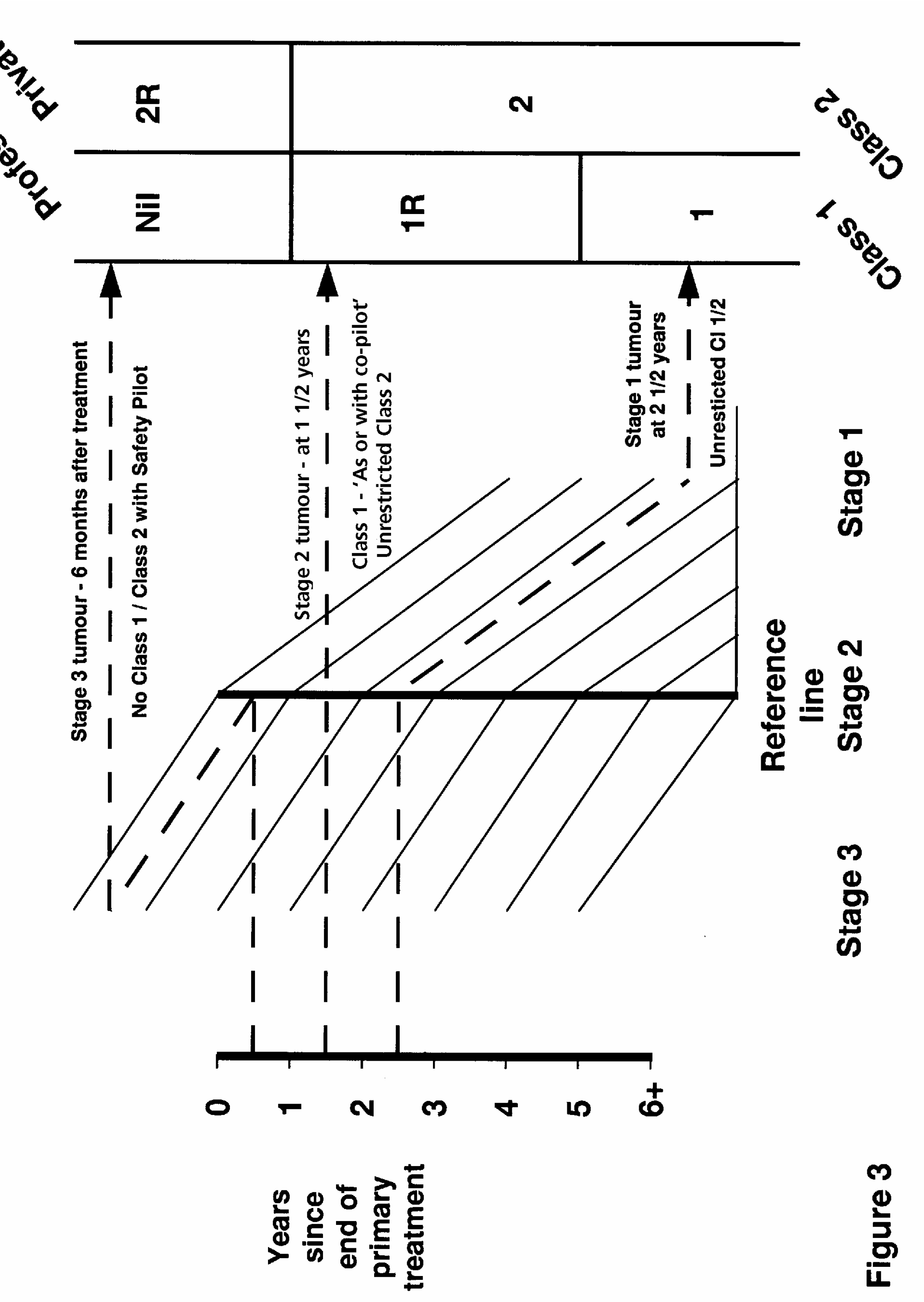

Figure 3

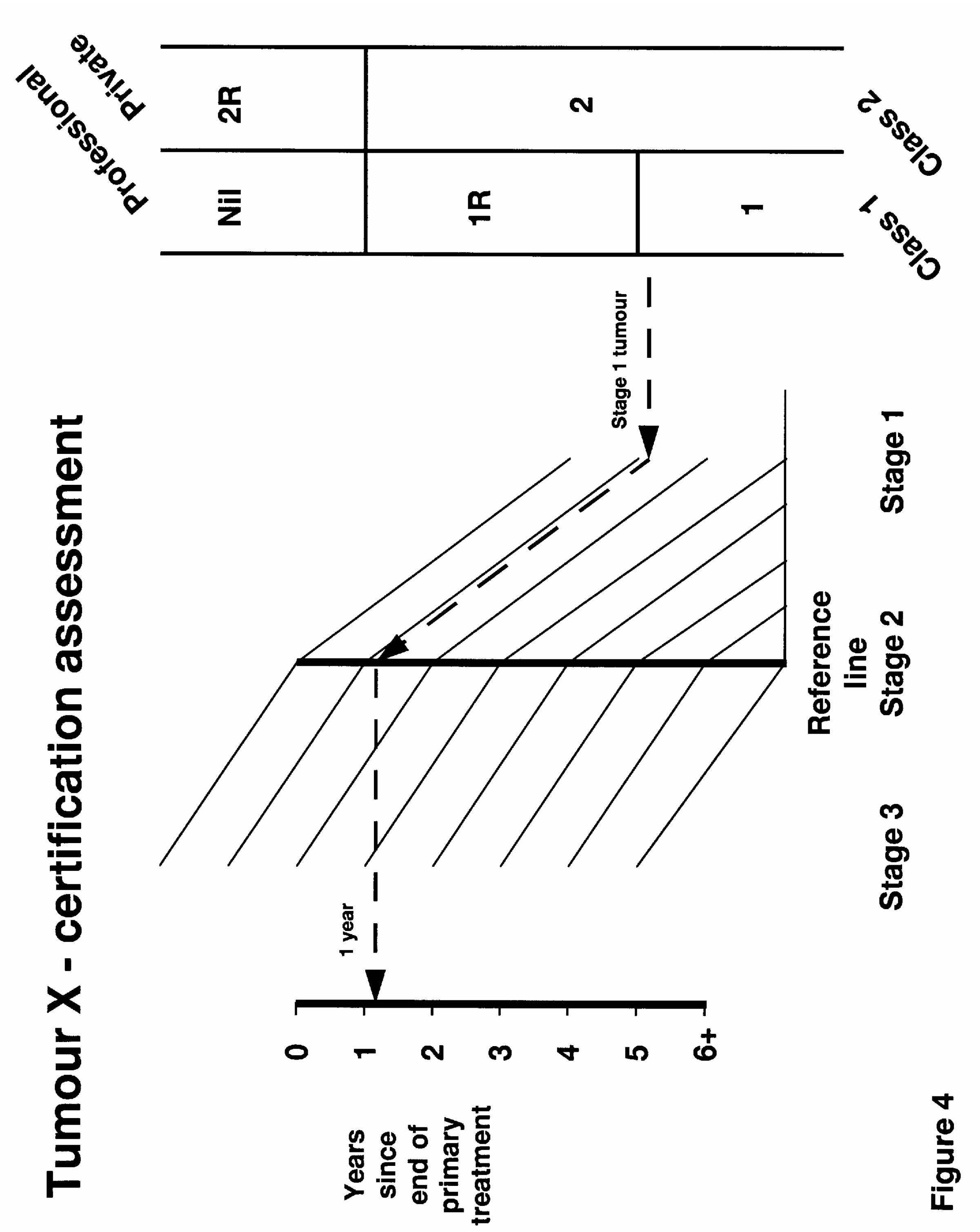
Tumour X - certification assessment
Professional
Private
Nil
2R
1R
2
1
Class 1
Class 2
Stage 1 tumour
1 year
Years since end of primary treatment
0
1
2
3
4
5
6+
Reference line
Stage 3
Stage 2
Stage 1

Figure 4

Tumour X - certification assessment

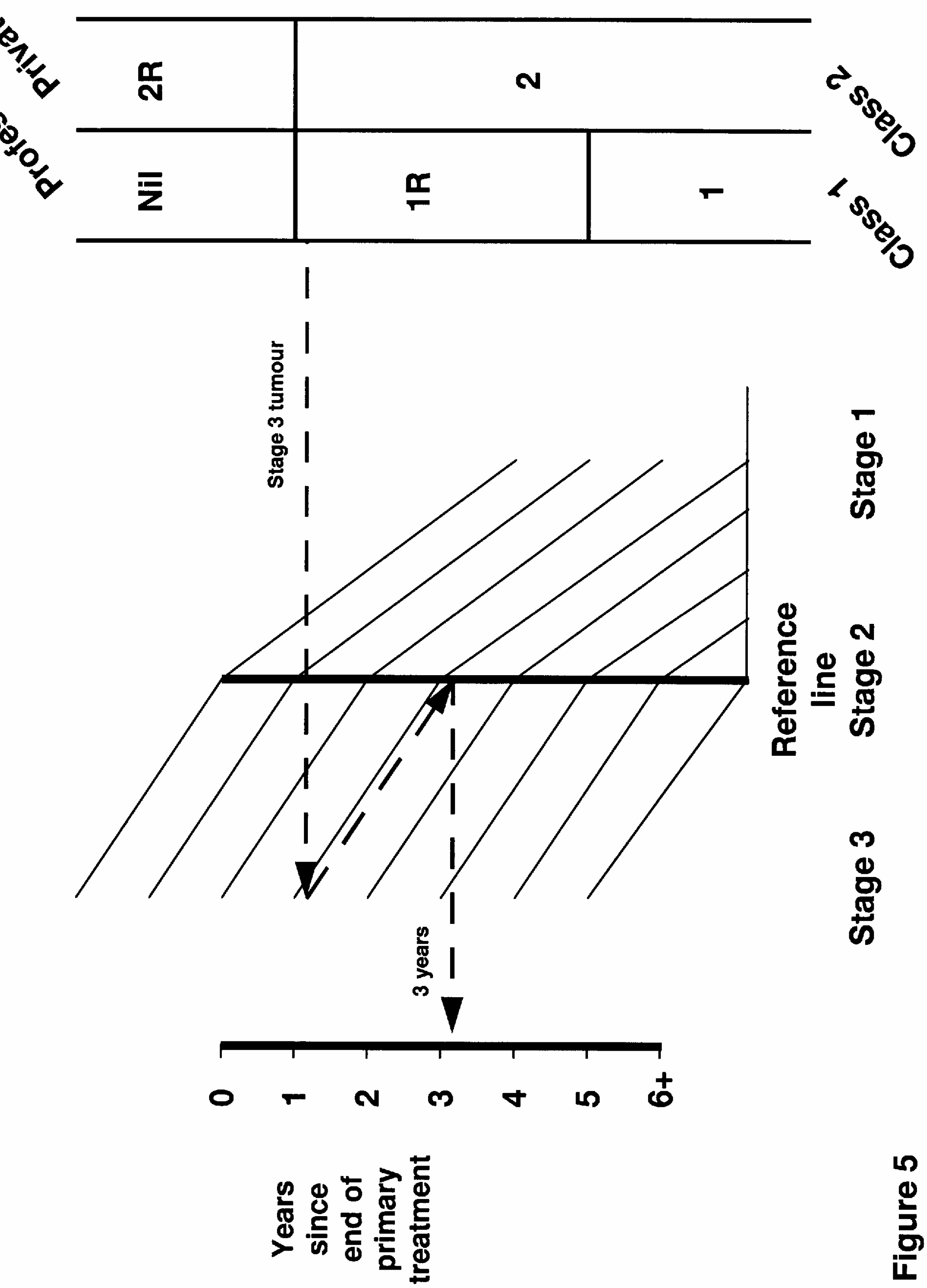

Figure 5

4 MELANOMA

Most pilots will present for recertification after excision of a stage 1 (no lymph nodes involved) primary lesion. If lymph nodes are involved, or become so, the prognosis is much worse, and an individual assessment in conjunction with oncology specialist advisors will be necessary. The best indicator of prognosis in melanoma is the vertical thickness of the excised lesion (Breslow thickness). This will be used as the main prognostic factor in recertification. The five year survival curves for three levels of thickness are presented in **Figure 6**, and have been obtained from a recent survey of 1 600 patients in Scotland.

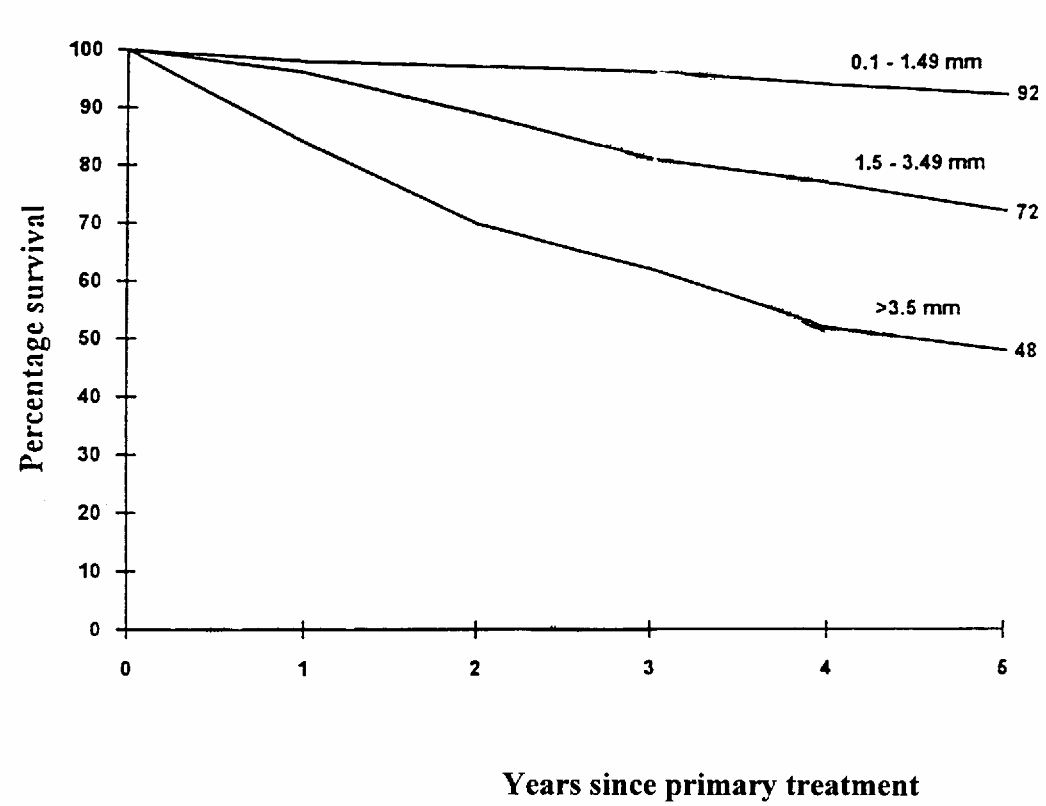

Figure 6: Five year survival after excision of Stage 1 melanoma.

The commonest site of recurrence of a melanoma is in the draining lymph nodes. This will not pose a significant incapacitation threat, but there is a small but significant incidence of cerebral metastases presenting as the first sign of recurrence. This has been estimated at 8% in a large Australian series, and similar figures were found in USAF personnel developing melanomata.

Figure 7 is an 'assessment' graph showing certification after primary excision of stage 1 melanoma based, as with the hypothetical tumour X, on the five year survival data in **Figure 6**, an 8% chance of the first metastasis being in the brain, and a 100% chance that a brain metastasis will cause an incapacitation. This can be used to assess certification after primary excision of a melanoma in air crew, provided the thickness of the lesion is known.

As an illustration of the use of an actual 'certification assessment' graph, **Figure 8** shows assessments of three thicknesses of tumour at various times from primary treatment. The upper line is the assessment of a thick tumour (greater than 3·5 mm), six months after the finish of primary treatment, which is likely to be wide excisional surgery. No Class 1 certificate is possible for another 18 months, though a Class 2 certificate, with a safety pilot limitation ('OSL') can be granted.

The middle line shows the assessment of a medium thickness tumour (between 1·5 and 3·49 mm) a year after surgery. Here a restricted Class 1 ('OML') certificate is possible, but the 'as or with co-pilot' ('OML') limitation will not be removed, assuming there is no recurrence, until five years have passed from the surgery.

The lower line shows certification following the excision of a thin tumour (0·1 to 1·49 mm) 18 months after the operation. Although the professional pilot had a multi-pilot ('OML') limitation for a year, this has now been removed, and both unrestricted Class 1 and Class 2 certification is possible.

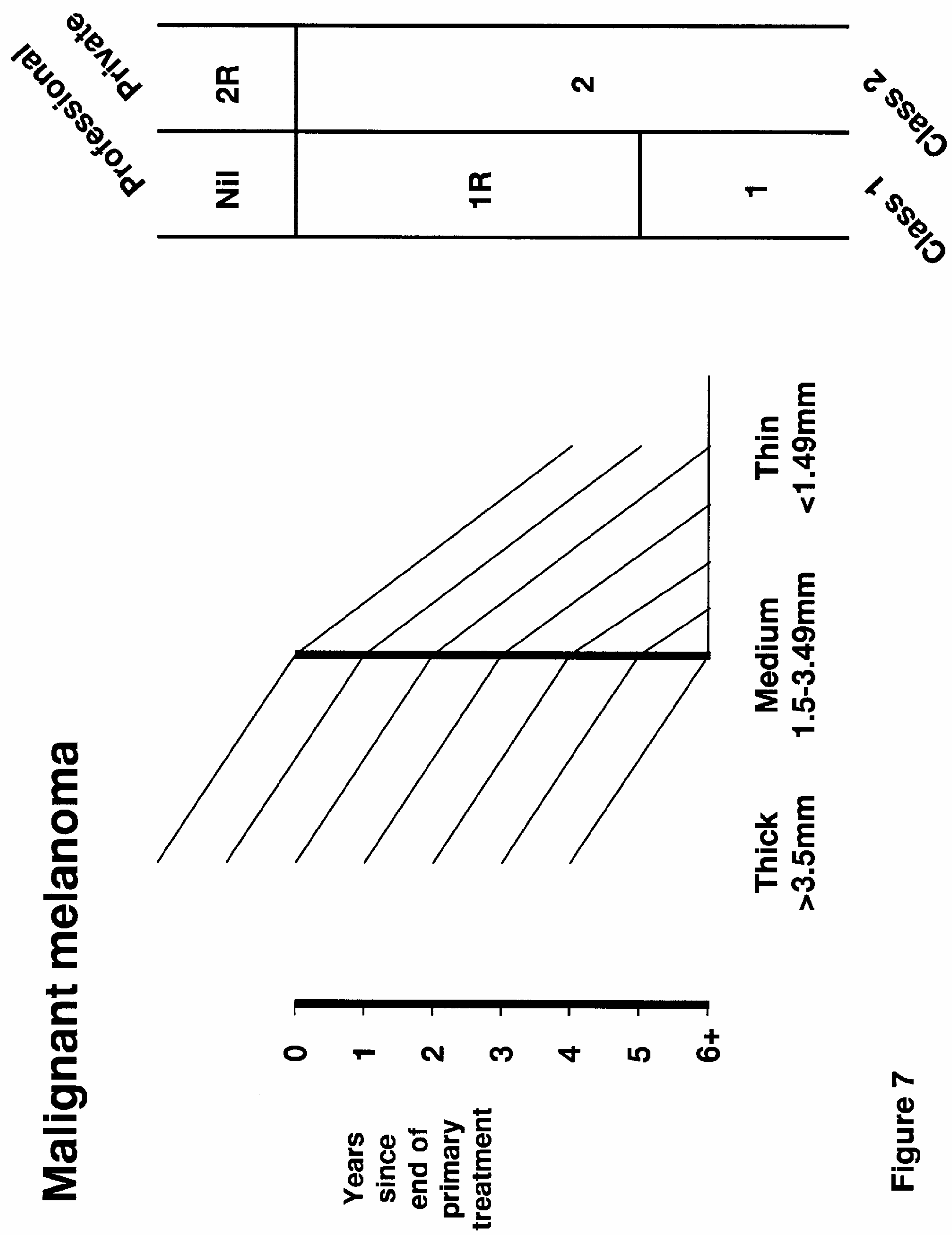
Malignant melanoma
Years since end of primary treatment
0
1
2
3
4
5
6+
Thick >3.5mm
Medium 1.5-3.49mm
Thin <1.49mm
Professional
Private
Nil
2R
1R
2
1
Class 1
Class 2

Figure 7

Malignant melanoma

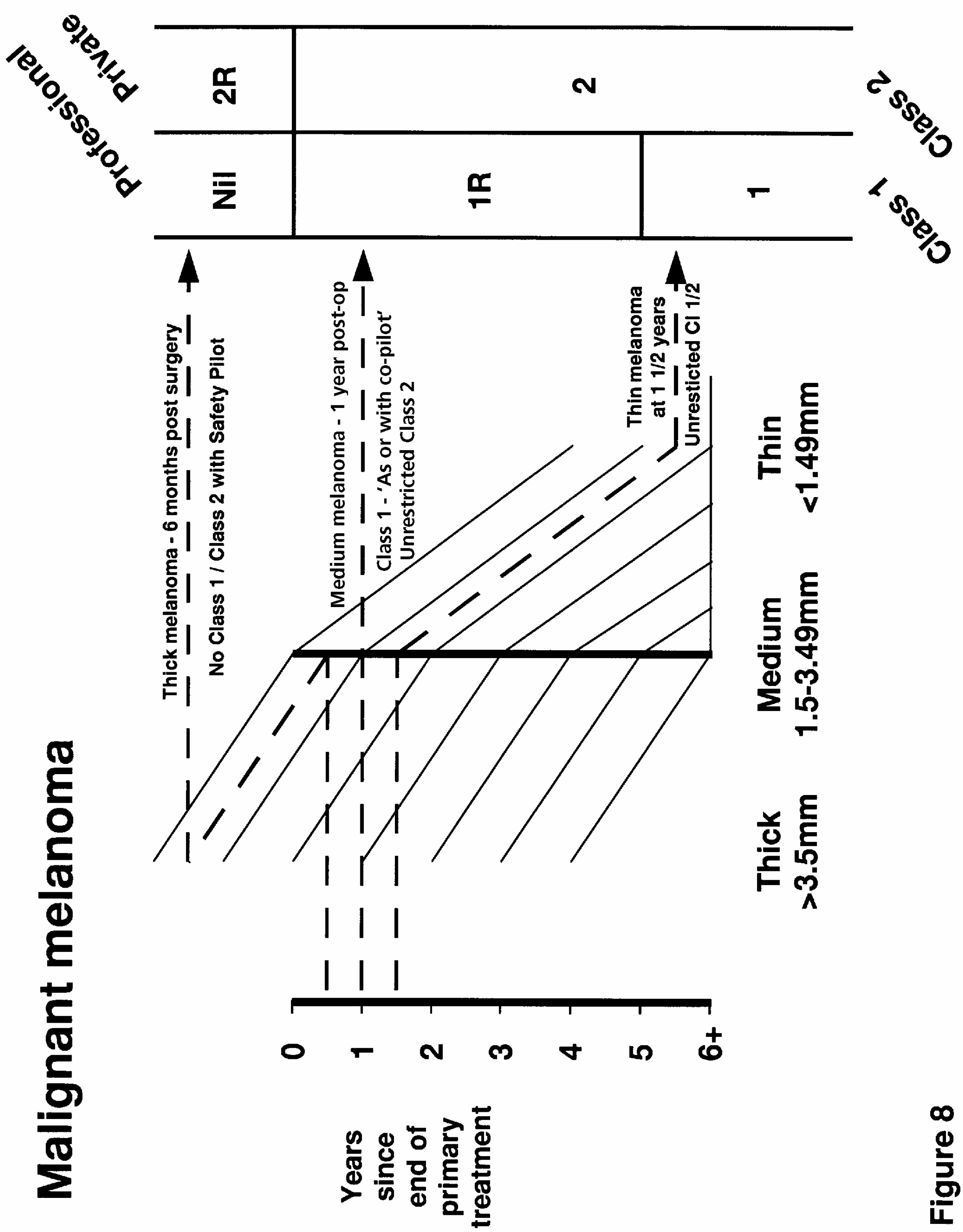

Figure 8

5 TUMOURS OF THE COLON AND RECTUM

Tumours of the colon and rectum account for approximately 15% of air crew and air traffic controllers applying for recertification following successful treatment for primary malignant disease. The classic method of pathological staging was devised by Cuthbert Dukes, pathologist at St Mark's Hospital, London, and is divided into stage A (T1,N0), stage B (T2/3/4,N0) and Dukes's stage C (T1/2/3/4,N1/2/3). The equivalent TNM classification is shown in parentheses. This has stood the test of time, and **Figure 9** shows the five year survival for patients after 'curative' resection of colonic and rectal tumours divided into Dukes's stages A, B and C. The mainstay of primary treatment is surgery, and it remains a salutary oncological fact that, despite the introduction of adjuvent radio and chemotherapy, the survival figures have not improved substantially. Indeed these figures have been obtained from major surgical series spanning the last 40 years (5,6).

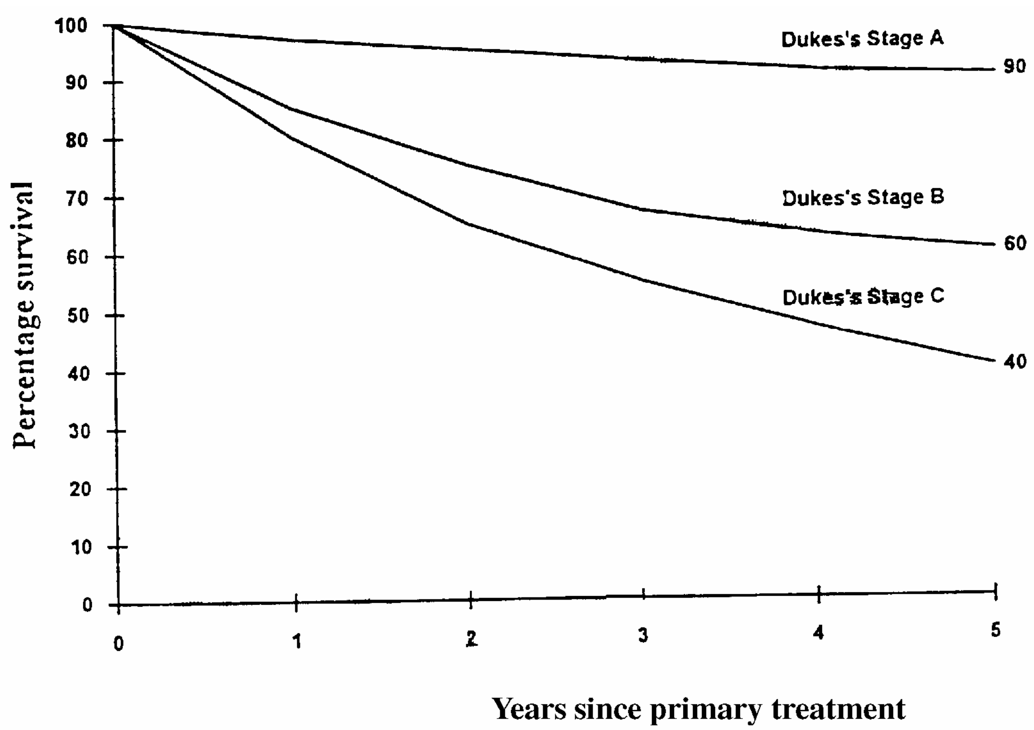

Figure 9: Five year survival after primary excision of colorectal tumours

Carcinoma of the large bowel recurs almost exclusively in the liver or locally. Metastases in the brain as a first sign of recurrence are extremely rare. For certification assessment it has been assumed that 50% of first metastases will be in the liver (with a further 45% locally and 5% elsewhere), with a 5% risk of one of these metastases causing a sudden or subtle incapacitation.

As with tumour X, calculations of the incapacitation risk for each stage of the disease are represented graphically in **Figure 10**, allowing a certification assessment for pilots who present following treatment for stages A, B and C. The graph is used as before.

From **Figure 10** it can be seen that Dukes's stage A patients/pilots have such a good prognosis, and such a low risk of incapacitation from the commonest metastases (liver), that they can gain an unrestricted class 1 certificate on their return to flying. Professional air crew with Dukes's B lesions would need to be restricted to multi-pilot ('OML') flying for three years, and those with Dukes's C lesions, five years. Private pilots can have unrestricted certification at the end of their primary treatment, whatever the stage of their primary.

6 SEMINOMA AND TERATOMA OF THE TESTIS

Testicular tumours also comprise approximately 15% of the air crew and air traffic controllers seeking recertification following treatment for malignant disease. This is not surprising given the relatively young age and male sex in this group compared to the normal population. The treatment of testicular tumours has been changed radically in the last 20 years by the introduction of powerful chemotherapy, and the majority of patients can now be cured. Two other factors make the recertification of pilots with this disease slightly different from other tumours. The first is the use of tumour markers (alpha-fetoprotein and beta-human chorionic gonadotrophin), which can, in teratomas, accurately predict the presence of recurrent disease in asymptomatic patients. The second is the intense surveillance in the first few years, when recurrence is likely, to which these patients are subjected. This means that pilots, if they are being treated at a major oncology centre, will be under a regime that is geared to discover sub clinical recurrent disease: an ideal situation in air crew. This can be reflected in their certification assessment.

There are a number of staging systems for testicular tumours, but one using the extent of the initial disease is the most useful for aeromedical certification. This is shown in the table below.

TESTICULAR TUMOUR	
Stage	Extent of disease
I	Tumour confined to the testis
II	Primary + abdominal lymph nodes
III	Primary + supra diaphragmatic lymph nodes
IV	Extra-lymphatic metastases (mainly lung)

The most common management of stage I disease in teratomas is a 'wait and see' policy after orchidectomy. Although 25% of these patients will relapse, this will be found during routine surveillance by a rise in the tumour markers, often before any anatomical disease can be located with even the most sophisticated of scanning equipment. In this situation unrestricted Class 1 certification can be maintained while the tumour markers are normal, and 75% of these pilot/patients will never need further treatment.

Stage I seminomas, because the tumour markers are not so accurate, may receive prophylactic treatment. This is usually in the form of radiotherapy, as the tumour is very radiosensitive. This produces a high cure rate (99%), and again unrestricted Class 1 certification is possible when the radiotherapy has finished. There is a move amongst oncologists to 'wait and see' in stage I seminomas, but here there will be a 15% relapse rate, and this will have to be monitored by serial CT or MRI scans. This type of policy may not be appropriate for air crew if they wish to maintain unrestricted certification.

Even with metastatic disease (stage II/III) the prognosis in testicular cancer is good compared to other tumours. If the bulk of the metastatic disease is small, cure rates of 90% can be achieved after chemotherapy for teratoma and radiotherapy for seminoma. More widespread (stage IV) disease has a relapse free rate of 60-70% at five years, but may require intensive chemotherapy to achieve this. If patients are disease-free three years after the end of treatment, it is highly likely that they will remain that way.

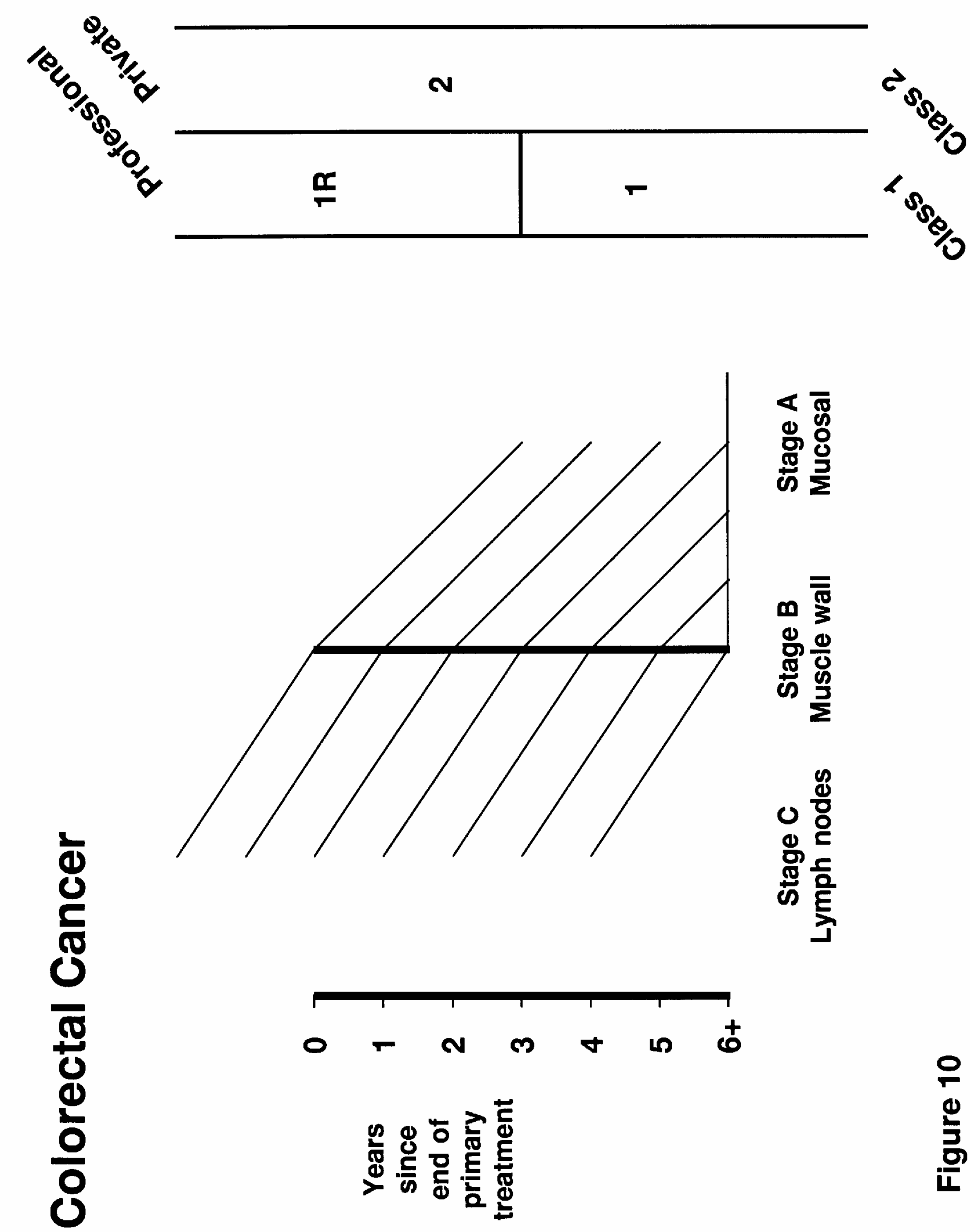
Colorectal Cancer
Years since end of primary treatment
0
1
2
3
4
5
6+
Stage C Lymph nodes
Stage B Muscle wall
Stage A Mucosal
Professional
Private
1R
1
2
Class 1
Class 2

Figure 10

Figure 11 shows the certification assessment following treatment for testicular tumours. Before recertification is possible, it will be necessary to make sure that there are no residual effects of treatment (bone marrow depression and anaemia). As noted above, certi fication can extend from initial unrestricted Class 1 in stage I cases, to no certificate in bad prognosis stage IV disease who is likely to need prolonged chemotherapy.

7 LYMPHOMA

Lymphoma, in its various forms, is perhaps the commonest malignancy in aircrew. It is broadly divided into Hodgkin's and Non-Hodgkin's disease, and because there are different ways of classifying these two types of lymphoma, and because there are considerable differences in prognosis, they are considered separately.

7.1 Hodgkin's lymphoma

With the advent of efficient staging and effective chemotherapy in the 1960's, the prognosis of Hodgkin's disease improved dramatically. The most widely used staging method was developed in Ann Arbor, and is outlined in the table below.

HODGKIN'S LYMPHOMA	
Stage	Extent of disease
I	One nodal area involved
II	Two nodal areas, same side of diaphragm
III	Two nodal areas, different sides of diaphragm
IV	Extra-nodal (visceral) disease

The relapse free rate ranges from 80% at five years in stage I to 65% in stage IV. The most likely site of metastatic disease is in the same or other nodal areas, and this, as was discussed with tumour X, carries a relatively small risk of incapacitation. However, there is a significant occurrence of bone marrow involvement, and this is the most likely source of subtle incapacitation risk. **Figure 12** shows the certification assessment in the usual way for Hodgkin's lymphoma, divided into stages I to IV and combining stages II and III which have a similar prognosis.

7.2 Non-Hodgkin's lymphoma

Although the Ann Arbor method of staging according to the site of nodal and extra-nodal involvement can be used in Non-Hodgkin's lymphoma, a better correlation with prognosis can be obtained by grading the tumour according to its cellularity. This is outlined in the table below.

NON-HODGKIN'S LYMPHOMA	
Grade	Histology
Low grade	Small cell
Intermediate grade	Large cell
High grade	Undifferentiated blast cells

Relapse free rates of 60% over five years can be expected with low grade tumours, falling to 40% in intermediate lesions, and 25% in the high grade group. Again the likely site of incapacitating secondary disease is the bone marrow, and this is reflected in the certification assessment in **Figure 13**. Because of the risk of late relapse, it is unlikely that a professional pilot would gain an unrestricted certificate in this disease.

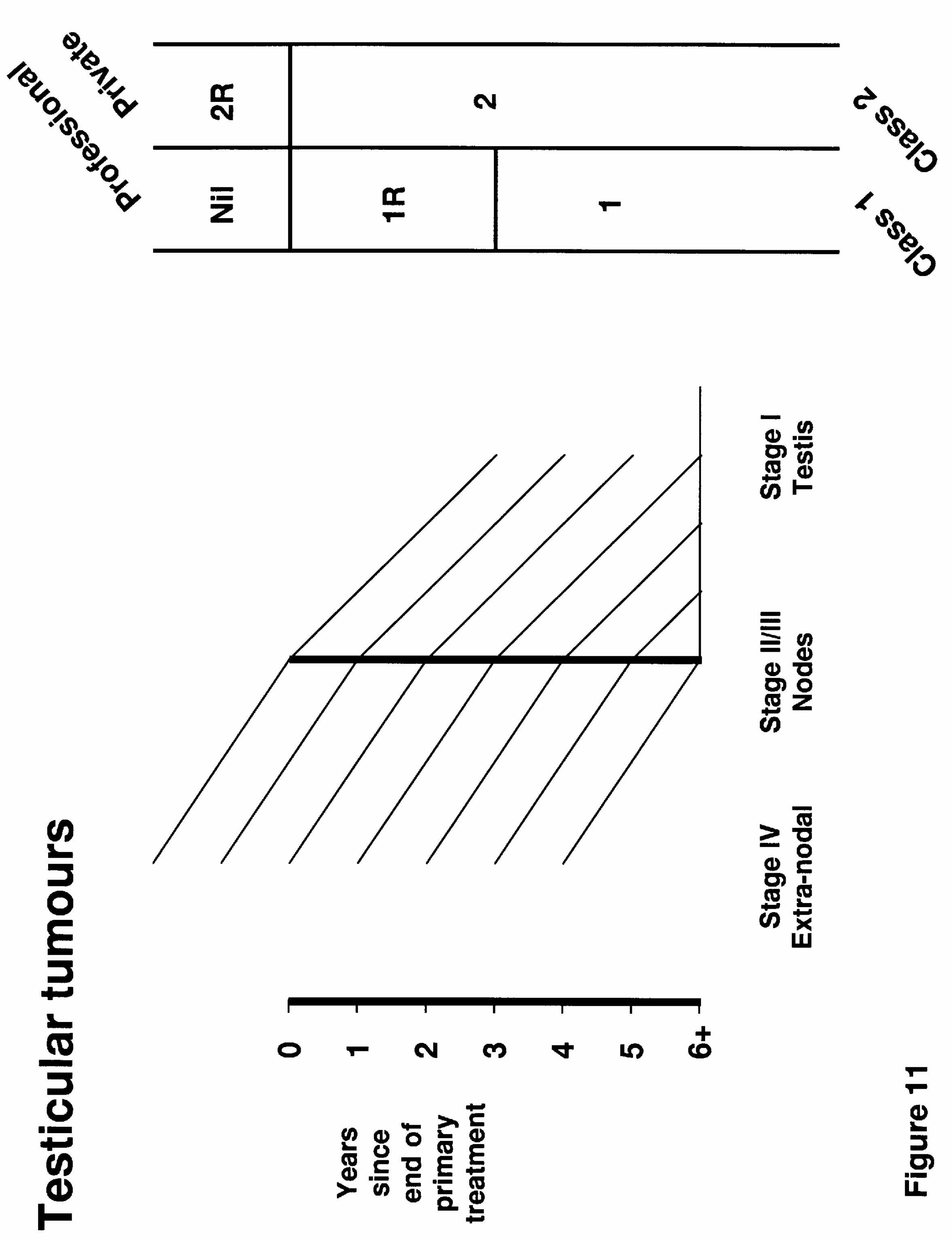
Testicular tumours
Professional
Private
Nil
2R
1R
2
1
Class 1
Class 2
Years since end of primary treatment
0
1
2
3
4
5
6+
Stage IV Extra-nodal
Stage II/III Nodes
Stage I Testis

Figure 11

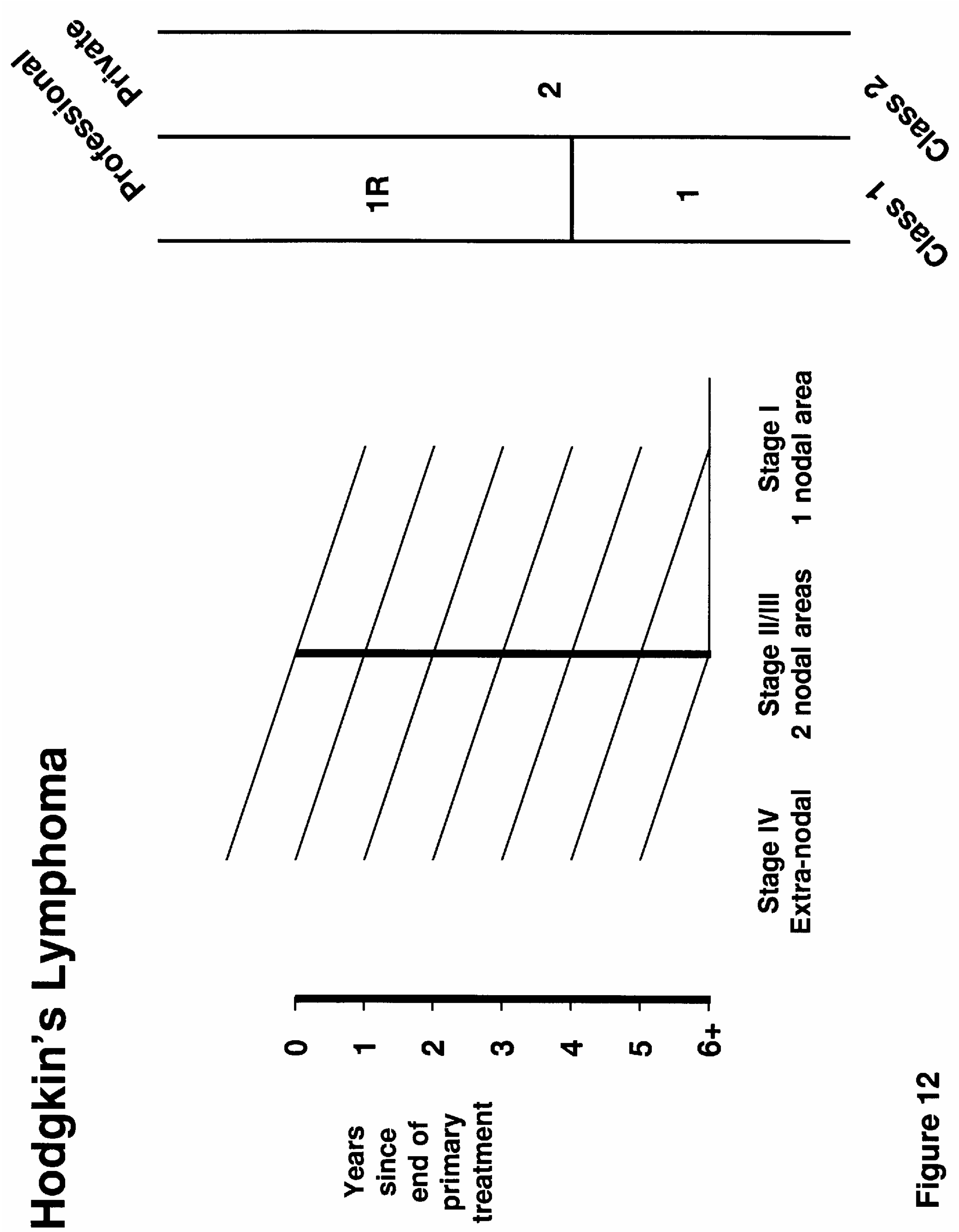
Hodgkin's Lymphoma
Years since end of primary treatment
0
1
2
3
4
5
6+
Stage IV Extra-nodal
Stage II/III 2 nodal areas
Stage I 1 nodal area
Professional
Private
1R
1
2
Class 1
Class 2

Figure 12

Non-Hodgkin's Lymphoma

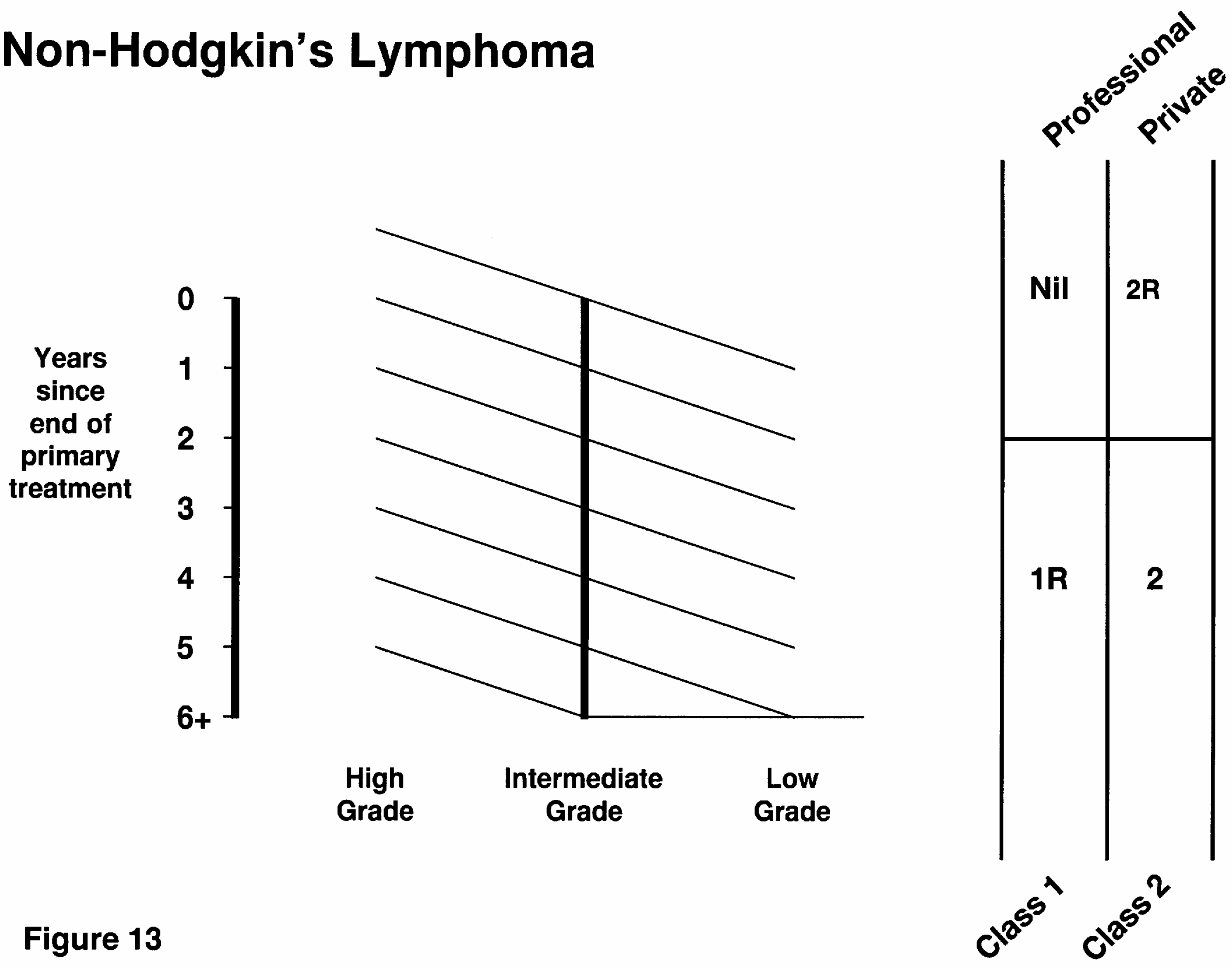

Figure 13

[8 Tumours of the lung

Although lung tumours are common, accounting for a third of cancer deaths in men, they are rare in aircrew. It is a disease of older persons, and it is possible that pilots are developing it after retirement from flying. Pilots also face a lifetime of medical examinations which perhaps encourages them not to smoke.

Many staging and grading systems have been promoted for the classification of lung tumours, but the commonest method divides the tumours into two according to their histology (non-small cell and small cell tumours) and then applies the standard TNM classification (Tumour, Node, Metastasis) to each. Tumours of broadly similar size and nodal status can then be grouped into four stages, which allow more manageable prognostic groups to be formed. Stage 1 is a localised small tumour, stage 2 has local nodes involved, stage 3 tumours are larger and may have more distant nodal involvement, and stage 4 denotes metastatic disease.

Small cell tumours have almost invariably metastasised by the time of presentation, and it is unlikely that any pilot would be able to return to flying with this type of tumour. Non-small cell tumours include squamous lesions, adenocarcinomas and large cell tumours (undifferentiated). Those that can be resected (by definition stage 1 and 2) carry the best prognosis. The mean five year survival following surgical removal of stage 1 tumours is 50%, and stage 2 lesions 25%. In both stages, squamous lesions tend to do slightly better than adenocarcinomas or undifferentiated lesions. The usual treatment in patients with stage 3 tumours is radiotherapy, and the prognosis is correspondingly bad, the mean five year survival being only 6%.

Lung tumours can recur locally, in regional lymph nodes, and distantly. The common sites of distant spread are the liver (40%), the adrenals (30%), the brain (25%) and bones (20%). These figures are for metastases found at autopsy. It is more difficult to find figures for the nature of the first recurrence. Approximately a quarter of patients who have metastatic melanoma in the brain will present with a brain secondary as a first recurrence. Pragmatically, therefore, it is assumed that a quarter of patients with post-mortem brain metastases from lung carcinoma will present with a brain secondary as a first recurrence.

The certification assessment graph for carcinoma of the lung is shown in figure 14. It assumes annual recurrence rates corresponding to the survival figures above, a 6% risk of the first recurrence being in the brain (a quarter of the post-mortem rate), and a 100% risk that a brain recurrence will cause an incapacitation.

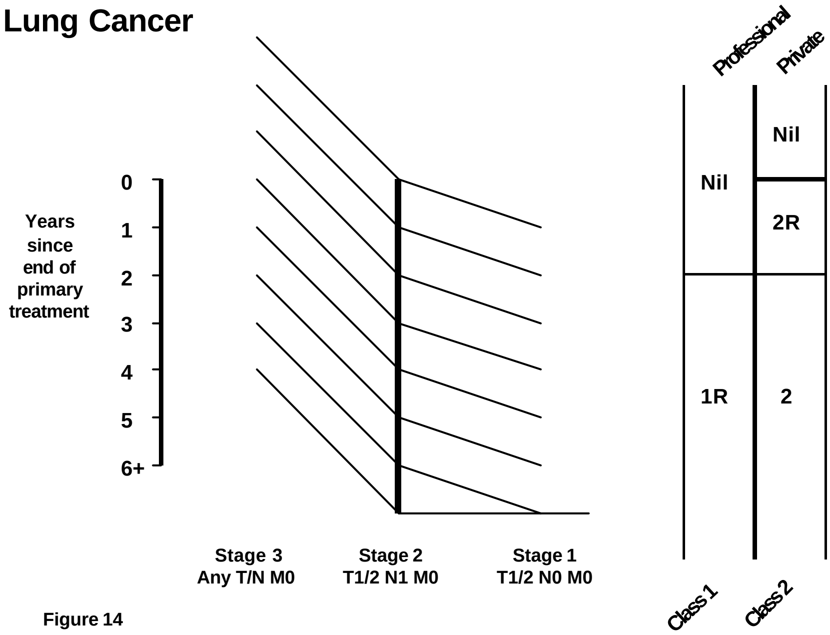

Figure 14

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9 Tumours of the Kidney

Certification for pilots who have had a carcinoma of the kidney removed is shown in figure 15. The five year survival ranges from 70% in stage 1 (within the capsule) and stage 2 disease (within the perirenal fat), 35% in stage 3 (venous or regional node involvement) to 10% on stage 4 (extranodal spread). The most ‘dangerous’ metastasis is again in the brain, but the incidence of this as a first recurrence is probably only about 2%. This produces a relatively ‘benign’ certification graph, but, as in each tumour, all macroscopic disease must have been removed before certification can occur.

Carcinoma of Kidney

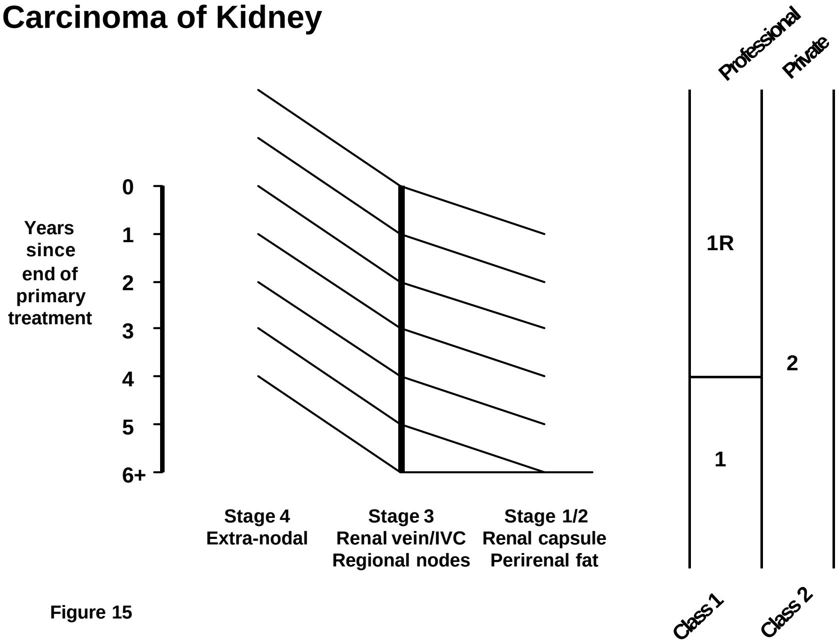

Figure 15

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10. Tumours of the Breast

One of the welcome features of modern aviation is the increase in woman pilots and air traffic controllers. An unwelcome feature, however, will be an increase in the prevalence of breast cancer among the aviation population. Breast tumours are classically divided into four stages. Stage 1 lesions are confined to the breast. Stages 2 and 3 imply increasing numbers of involved local nodes and increasing size of the primary. Stage 4 lesions have spread to distant sites, the commonest of which is bone, and approximately a fifth of patients will develop cerebral metastases.

The certification graph for breast cancer is shown in figure 16. The calculations are based on five year survival rates of 90% (stage 1), 50% (combined stages 2 and 3) and 10% (stage 4). A 5% risk (a quarter of the post-mortem rate) of a brain metastasis being the first sign of recurrence is again the most likely cause of incapacitation, and is used to calculate the graph slopes. Breast cancer, perhaps more than any of the other tumours discussed in this chapter, can recur many years after the primary treatment. Any pilot wishing to maintain her medical certificate should be followed up long term in an oncology clinic.

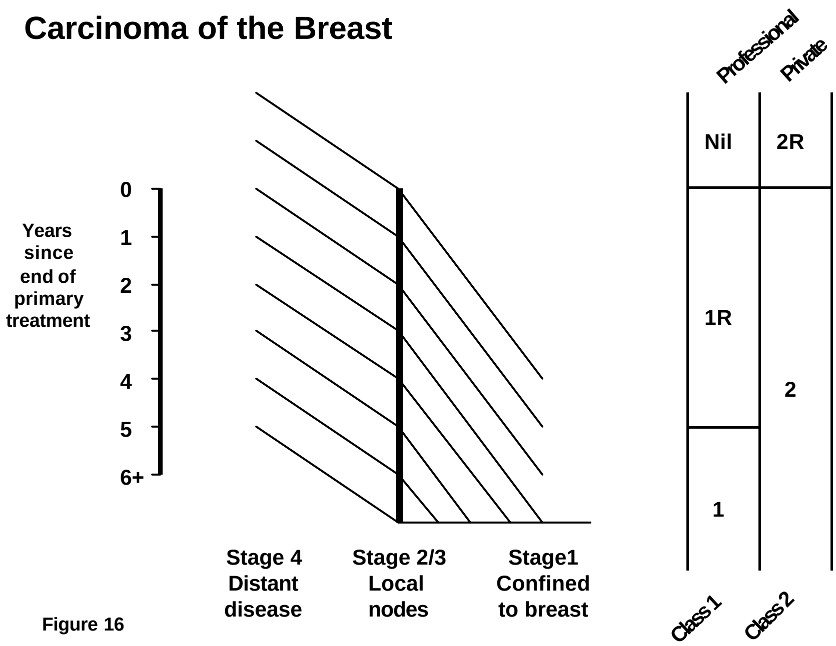

Figure 16

[Amdt. 3, 01.06.03]

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