A century after Crile (1906)

It is almost a century since Crile described the radical neck dissection for patients with head and neck cancer. In that paper Crile complained about the lack of attention of other physicians concerning the surgical progress in the treatment of head and neck cancer patients. Now, almost one hundred years later, many things have changed.

In his historical paper Crile described, as one of the first, the importance of removing lymphatic structures of the neck (the complete lymphatic block or radical neck dissection) in head and neck cancer patients. In great detail he described the anaesthesiology procedures, the surgical techniques, and the sacrificed structures, all illustrated with anatomical sketches. Additionally he described complications like: infections, hemorrhage, shock and collapse. In this same paper an evaluation study was presented in which he compared patients operated with a radical neck dissection (n = 12) to patients in which the lymphatic structures were not removed (n = 48). Patients operated with a radical neck dissection had a survival rate that was four times higher than patients without a radical neck dissection. Crile’s paper is one of the keystones of head and neck surgery, the radical neck dissection is still the surgical standard against which various modifications are compared.

Crile did not describe morbidity after surgery with radical neck dissection. Sacrificing the accessory nerve was not even mentioned in the text but only explained in one of the sketches as one of the structures to be sacrificed. Almost 50 years after the paper of Crile, Ewing (1952) was one of the first who described morbidity after radical neck dissection. Several types of morbidity were mentioned: disfigurement, pain in the shoulder region, loss of strength, reduced range of motion, loss of function of the shoulder, sensory disturbance, and restrictions in daily activities. Up to 62 % of the patients, operated with a radical neck dissection, had disfigurement of the shoulder and 46 % experienced shoulder pain. Other authors described higher incidences of shoulder complaints after radical neck dissection, even up to 100 %. Shoulder complaints after radical neck dissection are completely attributed to sacrificing of the spinal accessory nerve.

The high morbidity rates, and the gained insight in the biological behaviour of various cancer types, to estimate if a tumour has metastasised, led to modifications on the classical radical neck dissection. Bocca (1980)
described the functional neck dissection\(^4\), later to be called the modified radical neck dissection.\(^5\) In this modified radical neck dissection one or more of the following non-lymphatic structures are preserved: spinal accessory nerve, sternocleidomastoidus muscle, and internal jugular vein. The spinal accessory nerve seemed an important structure to preserve, in order to prevent shoulder morbidity. After modified radical neck dissections, with preservation of the spinal accessory nerve, the prevalence of shoulder complaints decreased, the prevalence rates were 18\% to 61\%.\(^6\)\(^7\) Further modifications in neck dissections were developed by removing only certain levels of lymphatic structures, that are prone to metastasis, instead of removing all levels. Four selective neck dissections (figure 1) are described: supraomohyoid neck dissection (levels I, II, and III), lateral neck dissection (levels II, III, and IV) posterolateral neck dissection (levels II, III, IV, and V), and anterior neck dissection (level VI).\(^5\) In these selective neck dissections all non-lymphatic structures (spinal accessory nerve, sternocleidomastoidus muscle, and internal jugular vein) are preserved. Supraomohyoid neck dissections are often performed in case of oropharyngeal squamous cell carcinoma, with a N0 tumour status and possible sufficient in the treatment of a selected group of patients with positive nodes at level I.\(^8\)\(^9\)

**Figure 1** Classification of levels used for neck dissections (1a). Anatomical structures that cross the cervical lymphatic structures and lymph nodes (1b). Situation after a radical neck dissection (1c).
Recently the classification of Robbins of 1991 has been updated. In this new classification the levels have been further modified. The levels I, II and V have been split into two levels, and are to be called level I a/b, level II a/b and level V a/b.\textsuperscript{10} (figure 2)

**Figure 2** New classification described by Robbins et al. 2002 \textsuperscript{10}

Morbidity after selective neck dissections has been described scarcely, and the studies included relatively small samples.\textsuperscript{3,11,12} Pinsolle described a group of 41 patients after supraomohyoid neckdissection of which 32% had minor problems, 5 % moderate and 3 % severe shoulder problems. \textsuperscript{13} Probably shoulder morbidity rates have decreased further as a result of selective neckdissections, but the evidence is still limited.

**Shoulder complains after neck dissection**

\textit{Sacrificing the spinal accessory nerve}

The spinal accessory nerve is a motor nerve, innervating the sternocleidomastoideus muscle and the trapezius muscle. Resection of the spinal accessory nerve leads to denervation of the trapezius muscle. The trapezius muscle exists of an upper, middle and lower part and has two major functions, shrugging the shoulder and stabilising the scapula on the thorax. Paralysis of the trapezius muscle will lead to a lateral gliding of the scapula and a lateral rotation.\textsuperscript{14} (figure 3)
As a consequence of the changed scapula position its possibility to move during shoulder movements decreases. As a consequence a reduced range of motion of the shoulder, abduction and forward flexion, appears. (figure 4) A reduced range of motion of the shoulder can cause dysfunction in activities in which the shoulder is needed like lifting heavy objects or reaching above shoulder level. Several patients also complain about pain after head and neck cancer treatment. The exact cause of this pain is not properly investigated. Several possible causes have been described like frozen shoulder, sternoclavicular joint hypertrophy, or myofascial pain as a consequence of stretching of muscles due to the changed scapula position. But these hypothesised causes for shoulder pain have never been investigated properly.

In some cases, after resection of the spinal accessory nerve, the trapezius muscle function remains (partly) intact. This is due to a double innervation by the cervical plexus of the musculus trapezius in about 18% of the patients.

**Preservation of the spinal accessory nerve**

Several patients after neck dissection with preservation of the spinal accessory nerve still suffer from shoulder complaints. The mechanisms of the shoulder complaints after modified or selective procedures with sparring of the spinal accessory nerve are unclear.
Figure 4 Scapula alata as a consequence of trapezius atrophy (4a) and a reduced abduction as a consequence of a changed scapula position (4b).

During neck dissection the spinal accessory nerve is lifted from its surrounding structures, and its supplying blood vessels are dissected which may result in a neuropraxia or the nerve may be dissected accidentally which results in a neurotmesis (permanent deficit). In these cases preservation or presumed preservation leads to spinal accessory nerve dysfunction and as a consequence shoulder complaints. But with an intact spinal accessory nerve and trapezius muscle function still shoulder complaints may arise which are interpreted as neuropathic pain or myofascial pain.\textsuperscript{19} Unfortunately little research has been done to substantiate these hypothesis whereas it is of great clinical importance for treatment possibilities.

More morbidity after head and neck cancer treatment

Beside shoulder complaints patients may suffer from other types of morbidity. Little is known about morbidity of the neck after head and neck cancer treatment. Clinically several patients complain about loss of sensation, pain, or a reduced range of motion of the cervical spine. In literature only a few papers describe this morbidity.\textsuperscript{19,20,21} These studies are performed on small samples, often without a physical examination. Consequences of neckdissection with or without radiation therapy on range

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of motion of the cervical spine are only described in studies that used questionnaires without actually measuring range of motion.\textsuperscript{22} Loss of sensation is thoroughly described in only one study by Saffold,\textsuperscript{23} although that study was primarily aiming at the results of the preservation of cervical root branches in selective neck dissections.

The influence of radiation therapy on loss of sensation, and range of motion is scarcely described, although clinically patients seem to suffer from fibrosis of soft tissues which decreases range of motion.

Pain is probably the most important type of morbidity of patients after head and neck cancer treatment. As mentioned before some hypotheses exist as how to explain post cancer treatment pain. Pain can be explained as neuropathic pain, pain in the clavicular or acromio-clavicular joint (probably nociceptive) and myofacial pain. The causes of pain are still hardly studied but clinically important for treatment modalities. Treatment modalities might be medication, physical therapy, and informing patients.

**Psychological consequences after head and neck cancer therapy**

After head and neck cancer treatment also psychological consequences are described. Beside the physical morbidity, psychological as well as social problems have their effect on well being and quality of life.\textsuperscript{24} Psychological consequences may be depression,\textsuperscript{25} distress,\textsuperscript{26} fear of recurrence,\textsuperscript{27} inadequate coping strategies\textsuperscript{28} problems in reintegration in work and lack of social support.\textsuperscript{29} After cancer treatment depression is, with a prevalence of 24 \% (range 1.5 \% - 50 \%), an important psychological morbidity.\textsuperscript{30} Depression has a construct in which physical and psychological domains are combined. Depression effects survival, recovery, treatment compliance, pain and quality of life.\textsuperscript{31,32} Therefor depression should be assessed adequately in the post treatment phase.\textsuperscript{33} Most studies describe psychological morbidity without taking physical morbidity into account. Especially in head and neck cancer patients both factors seem to be related. Therefor more studies are needed in which psychological as well as physical morbidity are analysed.

**Head and neck cancer and rehabilitation**

In the Netherlands 60,000 new patients are yearly diagnosed with cancer.\textsuperscript{34} About 10 \% of these patients, mostly man, are diagnosed with head and neck cancer.\textsuperscript{35} Although mortality rates for head and neck cancer patients are still

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high, through early diagnosis and better treatment possibilities more patients will survive cancer.\textsuperscript{36} In the last decade attention has been given to post cancer treatment rehabilitation.\textsuperscript{37,38} The last year’s treatments are more often multidimensional, aiming on physical and psychological problems. These programs are executed in groups to gain from peer support of fellow cancer patients.\textsuperscript{39}

Specific physical therapy programs for patients with shoulder complaints after neck dissections are proposed since 1976. (appendix 2) Only one study is performed as a controlled trial.\textsuperscript{40} Physical therapy programs differ in content and aims. Most programs aim at gaining a full, active and passive, range of motion, strengthening of shoulder muscles to stabilise the shoulder, and training shoulder function in activities in daily life. Besides exercises a physical therapy program may contain, relaxation or massage. Most programs are developed because of assumed spinal accessory nerve dysfunction. Several authors claim good results, but only the study of Salerno used a control group.\textsuperscript{40} She showed that physical therapy can be helpful in the rehabilitation after neck dissection for shoulder complaints. Nevertheless before setting up a program more insight in the exact morbidity after head and neck cancer treatment should be achieved to known where the program should focus on.

\textbf{Aim of our study}\n
In this thesis we are aiming at more insight in morbidity after head and neck cancer treatment (resection of the primary tumour, neck dissection and pre- or post-operative radiation therapy). We will study shoulder complaints and the role of the spinal accessory nerve, pain and the underlying pain mechanisms, range of motion, and loss of sensation. The consequences of dysfunction such as shoulder disability and activities of daily living, but also psychological problems (depression) and quality of life will be analysed. This thesis aims at a better understanding of consequences of type of neck dissection, especially the supraomohyoid neck dissection and the influence of radiation therapy. A better understanding of morbidity after cancer treatment must lead to specific rehabilitation treatment options in the near future.
References


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