

# Tyggeapparatets biologi – 2. Fysiologi



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## Munnhulens funksjoner– 1 PASSASJE - INNTAK AV SUBSTANS

- Gape +
- Fange og holde biter +
- Suge +
- Puste, inhalere damp, røyk , o.a. -



+ = protetisk behandling påvirker eller antas å kunne påvirke funksjon

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## Munnhulens funksjoner– 2 PASSASJE - INNTAK AV SUBSTANS

- Gape +
  - Fange og holde biter +
  - Suge +
  - Puste, inhalere damp, røyk , o.a. -
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- Føleapparat for smak, temperatur, struktur +
  - Mekanisk nedbrytning ved biting og tygging +
  - Salivasmøring +
  - Deteksjon fremmedlegemer/skadelige substanser +



+ = protetisk behandling påvirker eller antas å kunne påvirke funksjon

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### Munnhulens funksjoner– 3 PASSASJE - INNTAK AV SUBSTANS

- Gape +
- Fange og holde biter +
- Suge +
- Puste, inhalere damp, røyk , o.a. -
- ↓
- Føleapparat for smak, temperatur, struktur +
- Mekanisk nedbrytning ved biting og tygging +
- Salivasmøring +
- Deteksjon av fremmedlegemer/skadelige substanser +
- ↓
- Spytt -
- Mukosal absorpsjon (eg. snus) -
- Svelge +
- Kaste opp -

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### Munnhulens funksjoner– 4 NEUROFYSIOLOGISKE FUNKSJONER

- Kommunikasjon: Fonetikk, tale, synge +
- Kysse +
- Plystre +
- Sensorisk nytelse +
- Uttrykke emosjonell tilstand +
- Tannpresse +
- Gjespe -
- Nyse, hoste -

+ = protetisk behandling påvirker eller antas å kunne påvirke funksjon

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### Munnhulens funksjoner– 5 INSTRUMENTALE FUNKSJONER

- Blåse -
- Instrumentspilling +
- Transport av komponenter, væske, o.a. +

+ = protetisk behandling påvirker eller antas å kunne påvirke funksjon

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## Underkjevens bevegelse ved ulike funksjoner

1. Hvordan registrere bevegelser?
2. Hvilke funksjoner er evaluert?
3. Hvilke parametre for bevegelse er relevante?

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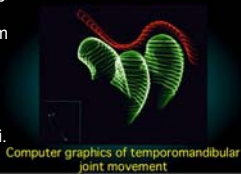
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## Underkjevens grunnbevegelser

**Hengselbevegelse:** finner sted i nedre leddkammer mellom caput mandibulae og undersiden av discus articularis. En isolert eller ren hengselbevegelse utføres ved små åpne- og lukkebevegelser 'hakke tenner', under tale. Bevegelsen foregår omkring tverraksen gjennom caput.

**Glidebevegelse** finner sted i øvre leddkammer idet discus articularis og caput mandibulae sammen glir bortover leddflatene på basis cranii. Ren eller isolert glidebevegelse utføres når underkjeven skyves litt frem (lage underbitt) og tilbake. Glidebevegelser har ingen akse.

**Rotasjonsbevegelse** utføres av caput mandibulae i den ene side omkring en loddrett akse. Bevegelsen utføres i høyre side når underkjeven (haken) føres mot høyre.



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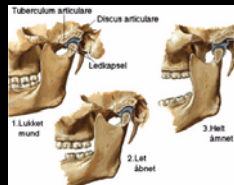
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## Underkjevens bevegelser sammensatt av grunnbevegelser

**Åpne- og lukkebevegelse** foregår samtidig og på samme måte i begge kjeveledd, dvs. bevegelsen er symmetrisk. Den består af hengselbevegelse i nedre, og glidebevegelse i øvre leddkammer.

Samtidig med at discus articularis caput mandibulae glir frem på tuberculum articulare utfører caput mandibulae hengselbevegelse mot underflater discus articularis.



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## Underkjevens bevegelser sammensatt av grunnbevegelsene

*Malebevegelse* er asymmetrisk, idet caput mandibulae blir i fossa mandibularis og roterer om en (næsten) loddrett akse på den side haken føres mot, mens det på den andre siden skjer en kombinert hengsel- og glidebevegelse. Bevegelsene utføres på skift i høyre og venstre ledd.

Bevegelsen av caput mandibula kan ofte sees og alltid føles, dels lateralt fra og dels gjennom forveggen av ytre øregang (høyre lillefinger i høyre øregang). Ved å måle avstanden mellom fortennene i over- og underkjeven kan pasientens gapeevne vurderes objektivt.

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## 1. Hvordan registrere bevegelser?

Metoder	(n=antall rapporter)
Selspot	(25)
Kinesiograph	(18)
Sirognathograph	(17)
Visiotrainer	( 8)
andre	(30)

2-frihetsgrader  
3-frihetsgrader  
6-frihetsgrader

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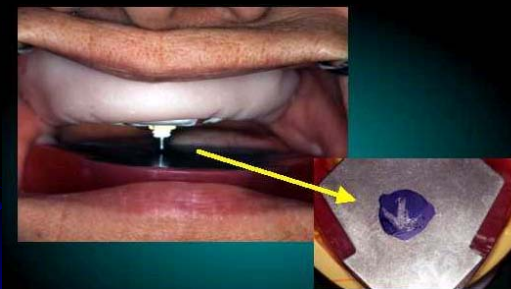
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## Metoder – piltracing i gane



Før 1900 – 1 frihetsgrad (xy) "Gothic arch"

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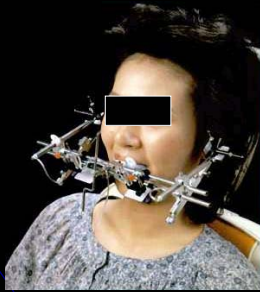
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## Metoder – pantograph



1950 - 2 frihetsgrader

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## Metoder – Kinesiograph MKG



Jankelson, 1975 - 3 frihetsgrader

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## Metoder – optisk tracing



Selspot, 1975 - 3 frihetsgrader - kontaktfrihet

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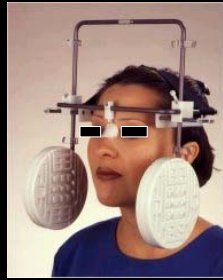
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## Metoder – ultralyd



1990 - 3 frihetsgrader

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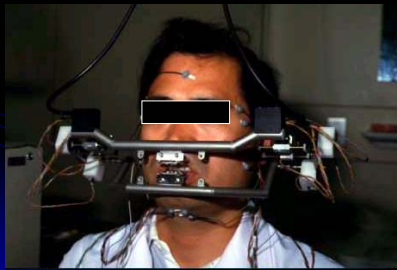
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## Metoder – magnettracing



Sirognatograph 1995 - 3 frihetsgrader -> 6 frihetsgrader

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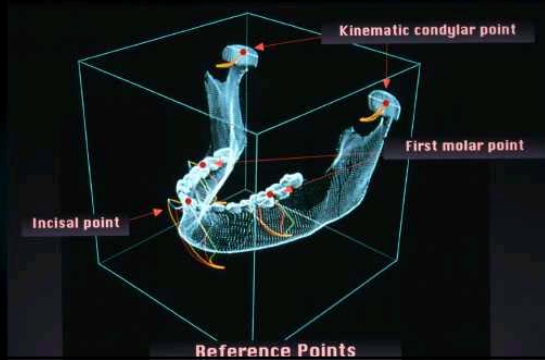
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## 6 frihetsgrader



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## Metoder – "far out"



2005?

New jaw tracking device in progress

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## 2. Hvilke funksjoner er blitt evaluert i rapporterte studier?

Funksjon	(n=antall rapporter)
Test food chewing	(72)
Chewing imitation	(11)
Opening-closing	(10)
Closing from PIOS (Postural inter-occlusal space)	( 6)
Border movements	(12)

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## Hvilke funksjoner er blitt evaluert i rapporterte studier? – hensikt med studiene

### 1. Basalforskning

- Neurologiske mekanismer – alder, kjønn, tanntap, eksperimentell
- Tyggeeffektivitet
  - Kost – konsistens, mykhet, størrelse, vekt, osv.

### 2. Behandling

#### Diagnostisk øyemed

- Kontrollpasienter vs. - TMD, malokklusjon, proteser, implantat
- Malokklusjon

#### Intervensjoner - resultat

- TMD - skinn bruk, okklusal ekvilibrerings
- Kirurgi – ortognatisk, ledd-, diskektomi
- Protetik – protese, implantat, faste broer
- Farmakologi – Parkinson

### 3. Test av metodologi

- Gyldighet/repeterbarhet- feilmåling, variasjonskoeffisient

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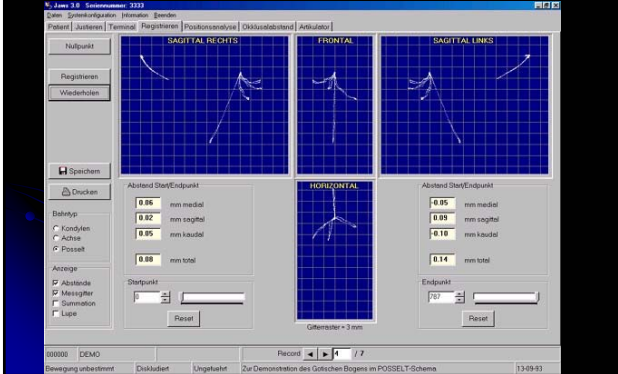
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### 3. Hvilke parametre for bevægelse er relevante?




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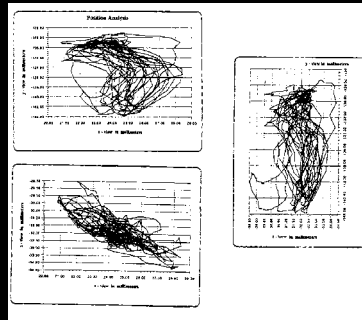
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### Hvilke parametre?

#### 1. Displacement




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### 1. Displacement - reported criteria

- Spatial (-xyz) -Open close (mm)
- Frontal/sagittal/horizontal plane
  - Vertical location at turnpoint (mm)
  - Approach/departure angle -Open, close (degrees)
  - Open-close trajectory:
    - width (mm)
    - amplitude  $Sq(x^2+y^2)$  (mm)
    - "core area" (mm<sup>2</sup>)
    - areas relative to defined axis (mm<sup>2</sup>)
    - envelope area (mm<sup>2</sup>)
  - Border limits relative to ICP (mm)
  - Jaw location at max. velocity -Open, close (mm)
  - Ratios: left-right("laterality index"), vertical- horizontal- sagittal axes, chewing location: border limits

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## Displacement

Study aim	Significant differences (n)				No differences (n)			
	Spa-	Fro-	Sag-	Hor	Spa-	Fro-	Sag-	Hor
Methodology	2	3	2	2	0	1	0	6
Food type	0	6	2	4	1	3	2	3
Diagnostic purpose	3	7	1	7	0	3	4	0
Basal mechanism	5	4	0	2	2	0	0	2
Treatment outcome	3	5	1	6	2	2	2	7

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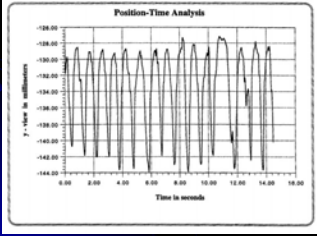
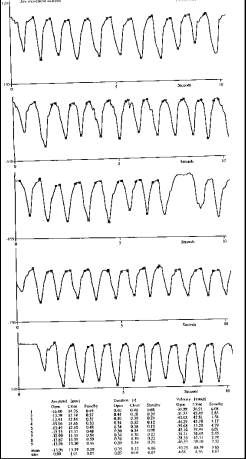
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## Hvilke parametre?

- Displacement
- Time

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## 2. Time, full cycle, open-, close-, occlusion phases

Study aim	Significant differences (n)				No differences (n)			
	full	open	clos	occl	full	open	clos	occl
Methodology	0	2	0	0	3	1	4	3
Food type	8	2	3	3	1	3	3	2
Diagnostic purpose	3	5	5	0	2	1	3	1
Basal mechanism	3	2	2	2	5	4	3	4
Treatment outcome	4	3	3	4	7	10	9	8

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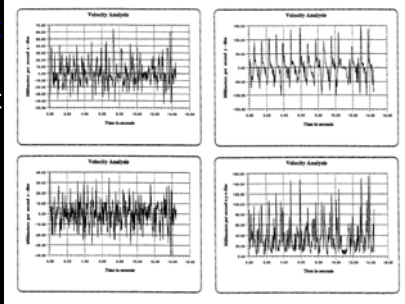
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## Hvilke parametre?

1. Displacement
2. Time
3. Displacement /time, i.e. velocity




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## 3. Velocity- reported criteria

- Opening - Closing phase
  - Mean, maximum
  - Ratio opening:closing phase
  - Maximum relative to:
    - turnpoint (%) (mm)
    - ICP (mm)
    - time
  - Decrease followed by increase < 3mm/s
  - Patterns: "swing", uni/bimodal-flat, smooth/irregular

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## Velocity

Study aim	Significant differences		No differences	
	(n)		(n)	
	open	close	open	close
Methodology	5	4	0	1
Food type	6	6	0	1
Diagnostic purpose	5	8	4	3
Basal mechanism	3	4	2	2
Treatment outcome	12	7	4	6

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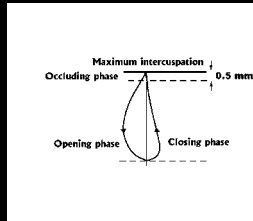
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## Hvilke parametre?

1. Displacement
2. Time
3. Displacement/time, i.e. velocity
4. Pattern recognition /classification

eks. tygging




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## 4. Pattern recognition

Patterns described in studies:

	2	3	4	6	7	12	14
Plane							
Frontal:	7	1	3	1	1	1	1*
Sagittal:	4	5	2				
Horisontal:	1		1				

\*14open x 14close patterns grouped into 9 main groups

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## Jaw movement- TMD patients

- Amplitude of movement in vertical, horizontal, and anteroposterior directions
  - no chewing
  - Chewing
- Reproducibility or consistency of movement
  - no chewing
  - chewing (pattern)
- Velocity
  - no chewing
  - chewing
- Vertical freeway space

Soboleva U, Jokstad A, Eckersberg T, Dahl BL. Chewing movements in TMD patients and a control group before and after use of a stabilization splint. Int J Prosthodont 1998;11:158-64

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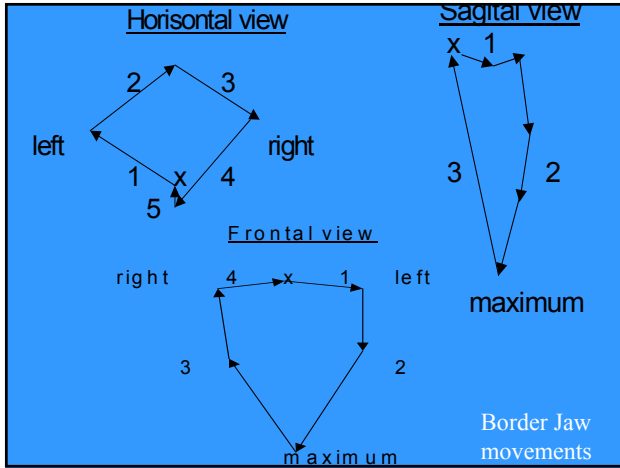
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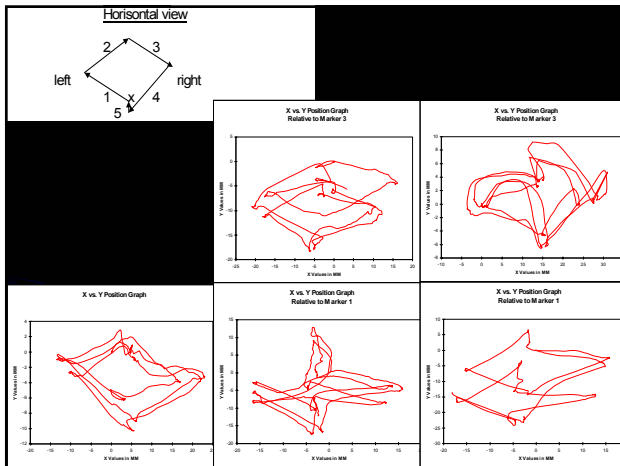
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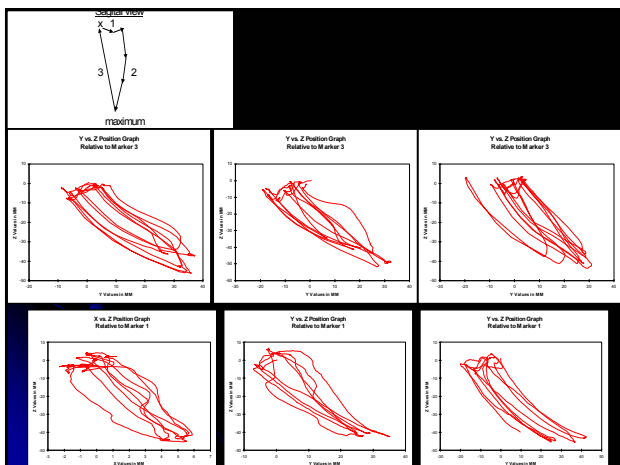
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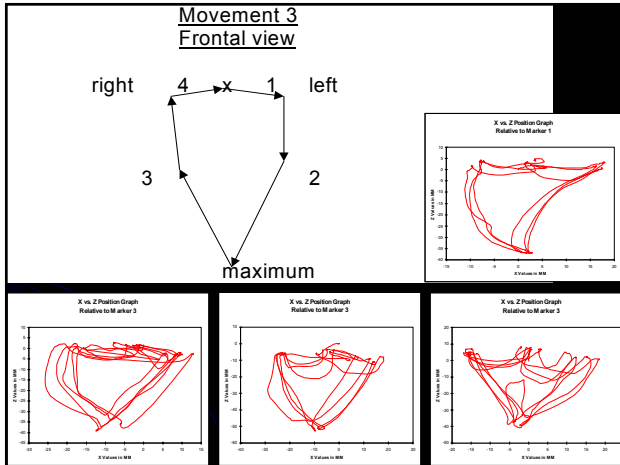
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## Hvilke andre måleparametre?

1. Displacement
2. Time
3. Displacement/time, i.e. velocity
4. Pattern recognition/classification
5. Other:
  - Rotation (degrees)
  - Acceleration (mm/s<sup>2</sup>)
  - Closest speaking space (mm)
  - Postural inter-occlusal space (PIOS) (mm)
  - Chewing preference side (%)
  - Torque (degrees)

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## Konklusjoner-1

There is a great variation in choice of criteria to describe aspects of jaw movements, as well as different recording apparatus.

The variation in study designs complicates valid comparisons of reported values of jaw movement during function.

The duration of the full and phasic parts of the cycles is only affected by food type and under some experimental conditions.

The duration seems to be less influenced by experimental and demographic variables compared to the effects on displacement and velocity of the jaw.

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## Konklusjoner -2

Only recent studies present jaw movement data based on 6 degrees of freedom, i.e. the jaw posture during movements.

There is a marked variation in reported significant effects of different demographic and experimental variables on chewing parameters.

Both Type I (alfa) and Type II (Beta) errors are probably present among many studies reporting jaw movement.

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